TDMoIP® Driven

RAD data communications

Installation and Operation Manual

IPmux-1, IPmux-1E

TDMoIP® Gateways

IPmux-1, IPmux-1E

TDMoIP® Gateways

Installation and Operation Manual

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General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

Safety Symbols

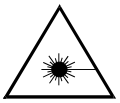
Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

.

Protective earth: the marked lug or terminal should be connected to the building protective earth bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions:

- **Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.**
- **Do not attempt to adjust the laser drive current.**
- **Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.**
- **The use of optical devices with the equipment will increase eye hazard.**
- **Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.**

ATTENTION: The laser beam may be invisible!

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective earth terminal. If an earth lug is provided on the product, it should be connected to the protective earth at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in earthed racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Connection of AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

Connection of DC Mains

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed form the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

Connection of Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The earthing and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution

To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention

Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good earth connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the earth bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching earth ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkströrungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Declaration of Conformity

Manufacturer's Name: RAD Data Communications Ltd.

Manufacturer's Address: 24 Raoul Wallenberg St.
Tel Aviv 69719
Israel

declares that the product:

Product Name: IPmux-1, IPmux-1E

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022 (1998)	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024 (1998)	Information technology equipment –Immunity characteristics – Limits and methods of measurement.
Safety:	EN 60950/A4 (1996)	Safety of information technology equipment, including electrical business equipment.

Supplementary Information:

The products herewith comply with the requirements of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC and the R & TTE directive 99/5/EC for wired equipment. The products were tested in a typical configuration.

Tel Aviv, March 18, 2001

Haim Karshen
VP Quality

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Preface

Foreword

This manual describes the technical characteristics, applications, installation and operation of IPmux-1 and IPmux-1E. In this manual the products will be referred to as IPmux-1/1E.

Manual Organization

This manual is organized as follows:

Chapter 1. Introduction

presents the main features versions, applications, functional description, and lists the technical specifications of IPmux-1/1E.

Chapter 2. Installation

provides detailed installation and operation instructions for IPmux-1/1E.

Chapter 3. Operation

provides general instructions for getting started, managing IPmux-1/1E by means of terminals and Telnet hosts, and provides typical configuration procedures.

Chapter 4. Tests and Diagnostics

describes the diagnostic and performance monitoring functions supported by IPmux-1/1E.

Appendix A. Boot Sequence for Downloading Software

provides instructions for the installation of new software releases.

Appendix B. Telnet

details management by Telnet.

Appendix C. SNMP Management

describes the SNMP and IP environments, and provides background information regarding the handling of management traffic.

Appendix D. TFTP Download Procedures

details management by Telnet.

Appendix E. Parameters and Screens

describes the configuration screens and parameters.

Conventions

Note	*A note draws attention to a general rule for a procedure, or to exceptions to a rule.*
Caution	A caution warns of possible damage to the equipment if a procedure is not followed correctly.
Warning	**A warning alerts to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the equipment. If these instructions are not followed exactly, possible bodily injury may occur.**

Quick Start Guide

1. Setting Jumpers – IPmux-1E ISDN Version Only

The IPmux-1E ISDN version contains jumpers for phantom feed.
Other IPmux-1/1E models do not require jumper configuration.

➤ **To set the IPmux-1E ISDN-S module jumpers:**

If necessary, change the settings in accordance with the specific requirements of your application:

- ENA – enable phantom feed
- DIS – disable phantom feed.

The phantom feed ENA/DIS setting influences the IPmux-1E BRI operation mode. When phantom feed is disabled, the S-interface can be configured (through software) to the TE or NT mode. When phantom feed is enabled, only the NT mode is possible.

2. IPmux-1/1E Operation

➤ **To operate the IPmux-1/1E:**

1. Power up the IPmux-1/1E unit.
2. Connect an ASCII terminal to IPmux-1/1E control port (IPmux-1/1E default setting: 19200, N, 8, 1).
3. Verify IPmux-1/1E startup by one of the following:
   - From the ASCII terminal, verify that the Self-Test has ended successfully.
   - Check the RDY LED on the on the left side of the front panel of the unit.
4. Connect the Ethernet link cable to the network port (connect an Ethernet link to the user port if the model includes one) and check the Sync LED.
5. Connect TDM cables to the TDM port.
6. Log in to the system software.

3. IPmux-1/1E Configuration

IPmux-1/1E configuration is performed from the ASCII terminal connected to the Control port. The system software is divided into three functions:

- System: General IPmux-1/1E system information.
- Configuration: Performs all configuration functions
- Performance Monitoring: Monitors overall performance

Note *Perform the following configuration procedures in the order given.*

Configuration

1. From the **Main** menu, type **2 (Configuration)**, **1 (General Configuration)** **1 (Host IP)**. Enter the Host IP parameters.
2. For IPmux-1: From the **Main** menu, type **2 (Configuration)**, **2 (E1/T1) Configuration**. Modify as necessary.

   For IPmux-1E: From the **Main** menu, type **2 (Configuration)**, **2 (ISDN** or **Analog Configuration)**. Modify as necessary.
3. For IPmux-1: If you selected a framed line type in the E1/T1 configuration, then the from the **Main** menu, type **2 (Configuration)**, **5 (DSO Bundle Configuration)**. Define timeslots.
4. From the **Main** menu, type **2 Configuration**, **4 LAN Configuration**. Modify as necessary.
5. From the **Main** menu, type **2 (Configuration)**, **3 (Connection Configuration)**. Select the connection mode and enter the other parameters as necessary.

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Chapter 1
Introduction

1.1 Overview

IPmux-1 and IPmux-1E (referred to as IPmux-1/1E) offer a solution for extending traditional E1/T1, ISDN, or POTS TDM services transparently over Packet Switched Networks (PSNs) such as IP, Ethernet, and MPLS networks. The device converts the data stream coming from its user ports into configurable sized IP packets that are extended over the Fast Ethernet network port, and vice versa. IPmux-1/1E offers end-to-end synchronization for voice/leased line applications. IPmux-1/1E also features a Fast Ethernet user port for data (Ethernet) connectivity to the IP/Ethernet network. Management is performed locally by a terminal, or remotely via Telnet or SNMP.

IPmux-1/1E offers:

- E1/T1 service in IPMux-1 or E1/T1 with echo canceling in IPmux-1E
- ISDN BRI ('S') extension in IPmux-1E
- Analog extension (FXS, FXO, or E&M) with optional echo canceling in IPmux-1E.

The IPmux family implements TDMoIP® technology to carry TDM transport over IP. IPmux-1E ISDN BRI channels are transported as TDM timeslots, while the analog FXS/FXO/E&M channels are digitized and carried as fractional E1/T1 with CAS.

Versions

- **IPmux-1 with E1 interface**
  - Balanced line with an RJ-45 (120Ω) connector
  - Unbalanced line with an RJ-45 (75Ω) connector (RJ-45 to BNC cable adapter is supplied)
- **IPmux-1 with T1 interface –** Balanced with an RJ-45 connector
- **IPmux-1E with ISDN BRI interface –** 4 ISDN 'S' RJ-45 connectors
- **IPmux-1E with FXS Interface –** 4 analog 'FXS' RJ-11 connectors, and optional echo canceller
- **IPmux-1E with FXO interface –** 4 analog 'FXO' RJ-11 connectors, and optional echo canceller
- **IPmux-1E with E&M interface –** 4 analog 'E&M' RJ-45 connectors, and optional echo canceller

- **IPmux-1E with E1 interface and an echo canceller**
  - Balanced line with an RJ-45 connector
  - Unbalanced line with a mini-coaxial connector (TBNC)
- **IPmux-1E with T1 interface and an echo canceller**
  - Balanced line with an RJ-45 connector
  - Unbalanced line with a mini-coaxial connector (TBNC).

An external clock port and user Ethernet interface are optional for IPmux-1/1E.

Options

IPmux-1/1E is a 1U high, easy-to-install standalone unit. A rack mount installation option is available: RM-25 for IPmux-1, and RM-26 for IPmux-1E.

IPmux-1 can be ordered with AC or DC power supply. IPmux-1E is only available with AC power supply.

Applications

Typical IPmux-1/1E applications are shown with E1/T1, ISDN, and FXS/FXO/E&M interfaces.

Figure 1-1 illustrates multiplexing voice and data over an Ethernet link.

Figure 1-2 shows an E1/T1 circuit extension over an IP/Ethernet network.

Figure 1-3 illustrates mixed ISDN BRI and POTS support application of V5.1 concentration of ISDN BRI remote terminals.

Figure 1-4 shows mixed ISDN BRI and POTS support application of voice concentration.

Figure 1-5 illustrates extending ISDN BRI ports and LAN of a small office.

Figure 1-6 shows Ethernet-based multi-tenant with voice and data integrated access.

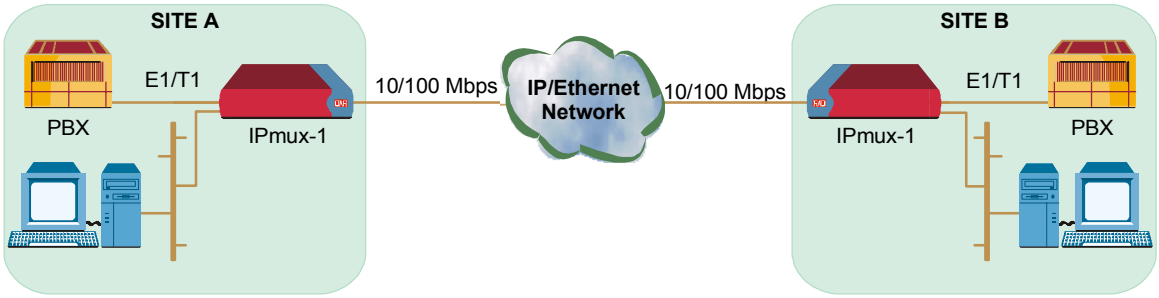

Figure 1-1. Multiplexing Voice and Data over an IP/Ethernet Link

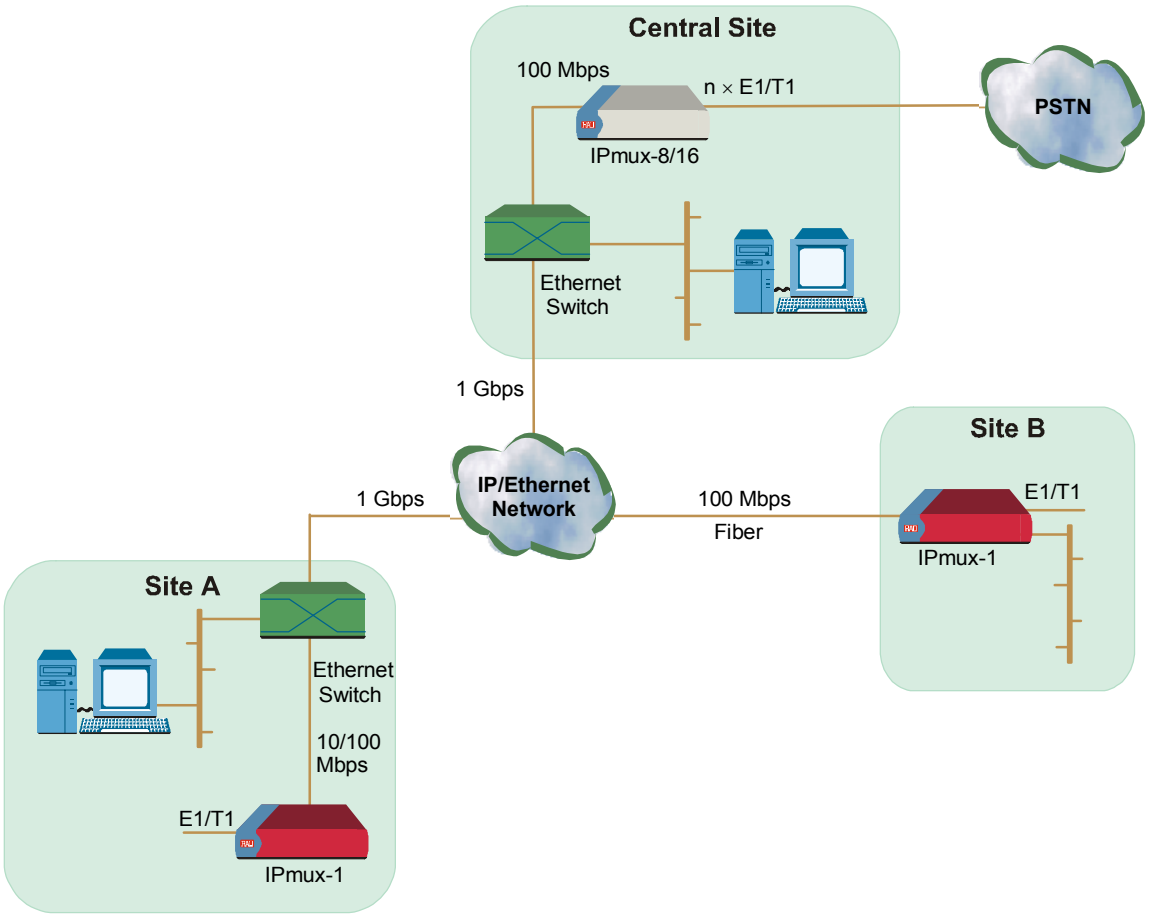

Figure 1-2. E1/T1 Circuit Extension over an IP/Ethernet Network

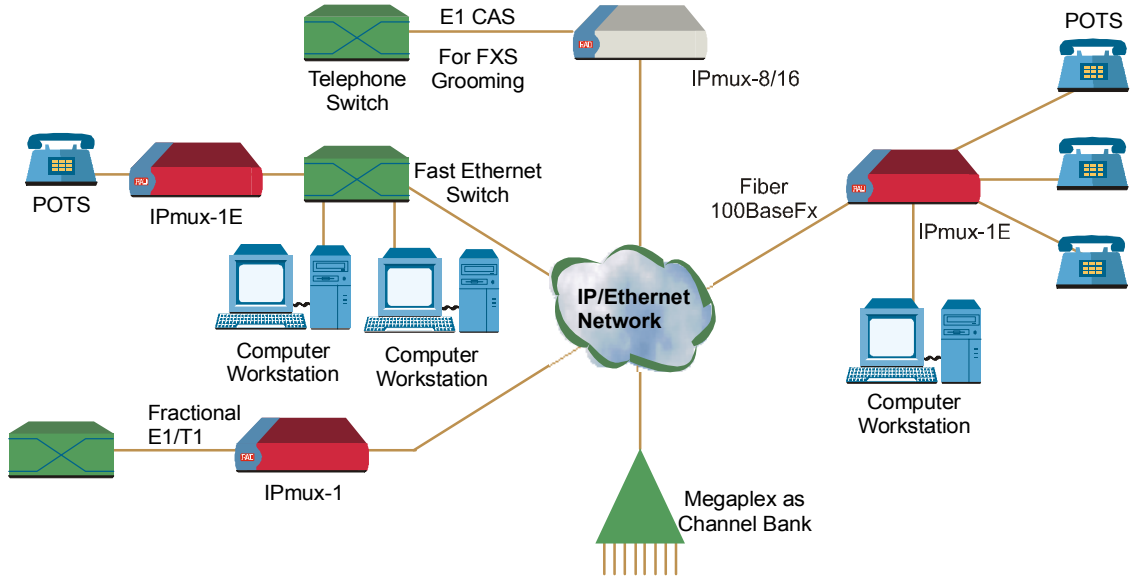

Figure 1-3. Analog Voice Application

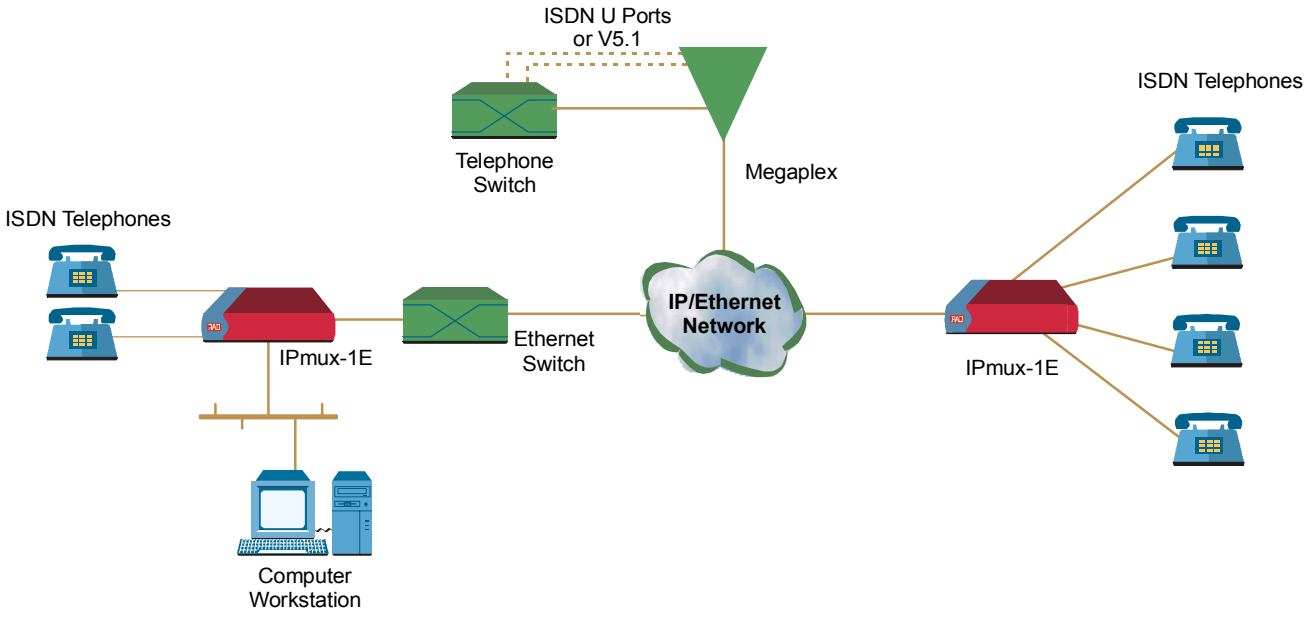

Figure 1-4. Digital ISDN Application (V5.1 Concentration of Remote BRIs)

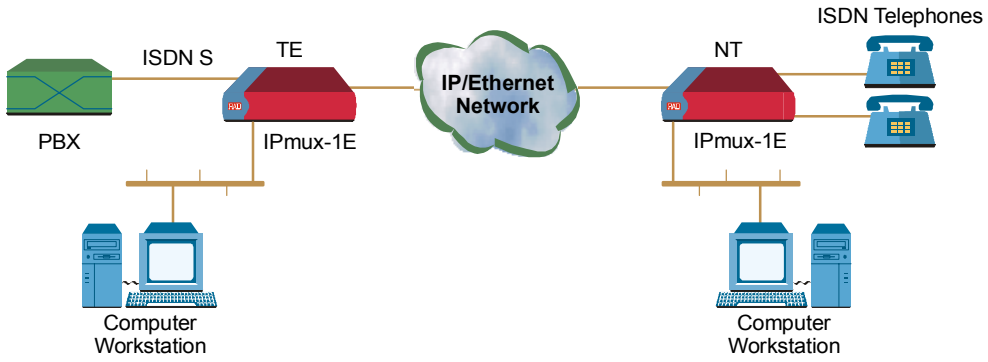

Figure 1-5. Extending ISDN BRI Ports of a Small Office

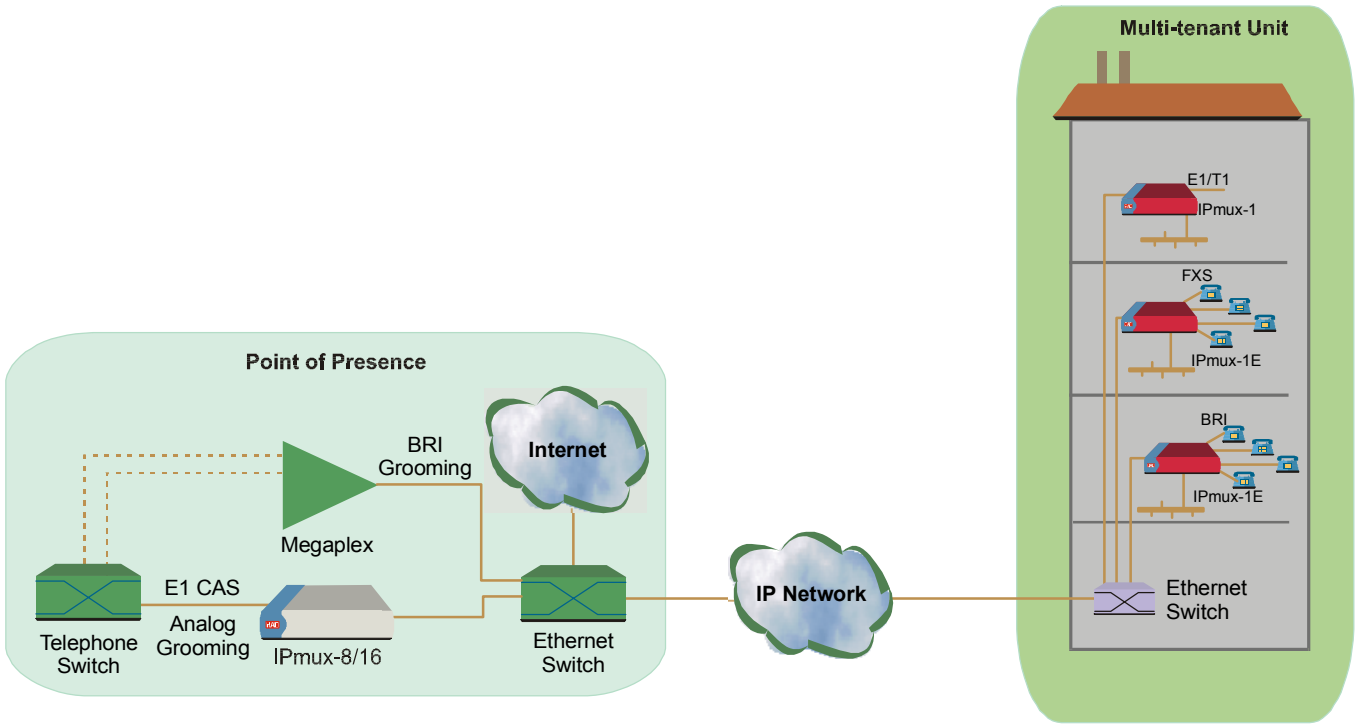

Figure 1-6. Ethernet-based Multi-tenant Application with Voice and Data Integrated Access

Features

Management

IPmux-1/1E can be managed locally by connecting an ASCII terminal to the RS-232 port on the front panel, or via Telnet or SNMP. The SNMP management capability enables fully graphical, user-friendly management using the RADview Service Center TDMoIP® network management stations offered by RAD, as well as management by other SNMP-based management systems.

T1

The T1 port and framers comply with ANSI T1.403, G.703, and G.704 standards. T1 jitter performance is according to G.824 and TR-62411. The T1 framers support unframed, SF, ESF and CAS framing. The T1 port supports long haul and short haul input signals and can be monitored for alarms and error statistics. FDL and transmit PRM for T1/ESF are also supported.

E1

The E1 port complies with G.703, G.704, and G.823 standards. E1 framers comply with G.704. The E1 framers support unframed, framed, CRC4 MF and CAS MF framing. The E1 port supports long haul and short haul input signals and can be monitored for alarms and error statistics.

ISDN BRI

IPmux-1E has 4-ports, S-interface only. Each port can be configured as either NT or TE (Network/User) by jumper and software; NT or TE is configured per device.

IPmux-1E can be configured to 1, 2, 3 or 4 active ports.

IPmux-1E works in transparent mode (no termination/compression of the BRI "D" channels). It operates opposite a Megaplex unit, as a concentrator in transparent mode, or opposite another IPmux-1E with ISDN BRI ports.

FXS/FXO/E&M

IPmux-1E has 4 FXS/FXO/E&M interface ports for POTS connection. An IPmux unit with an E1/T1 CAS interface can groom FXS/FXO/E&M channels from the remote sites. IPmux-1E analog options interwork with Megaplex analog and E1/T1 modules via the Megaplex TDMoIP® main link (ML-IP).

IP

The data stream coming from the E1 or T1 port is converted into IP packets that are transported over the Fast Ethernet port, and vice versa.

TDM bytes are encapsulated in a UDP frame that runs over IP and over Ethernet.

The number of TDM bytes in an IP frame is configurable for throughput/delay tradeoff.

Each device has a single IP address (Host IP). A configurable destination IP address is assigned to the IP packets. IP ToS field support can be configured for IP Level Priority. In Redundancy Mode, a secondary IP Address is used for the backup bundle; this device IP Address defines a response for a ping, but not for management.

Ethernet Ports

IPmux-1/1E is available with two Ethernet ports (user and network ports). The optional user Ethernet port is used for user LAN connectivity/access, in addition to the TDM service connectivity.

The Ethernet ports work in either transparent bridge mode or in a second mode that enables user port rate limiting.

The Ethernet network port can be either UTP or fiber. The Ethernet user port is UTP only.

- **Fiber option** – standard 100BaseFx full-duplex port (see *Table 1-1*).
- **UTP option** – A standard 10/100BaseT half/full-duplex port with auto-negotiation support. If auto-negotiation is disabled, Ethernet mode should be configured.

Note *Half-duplex operation in the IPmux-1/1E network port is not recommended, because collisions and backoffs cause large delay variation and may exceed the delay variation buffer tolerance at the receiving end, causing buffer underflows and errors to occur.*

Table 1-1. Fiber Options

Interface Type	Wavelength (nm)	Optical Power (dBm) Min	Max	Receive Sensitivity (dBm)	Optical Budget (dB)*	Loss (dB/km) Min	Max
SC multimode	1310	-20	-14	-31	8*	1	4
SC single mode	1310	-20	-14	-31	8*	0.5	0.8
LC multimode	1310	-19	-14	-32	10*	1	4
LC single mode	1310	-15	-8	-32	14*	0.5	0.8

*Permitted fiber optic cable length differs according to fiber characteristics, splices, and connectors.

Note

When a user port option (only UTP) is chosen, the network fiber option is LC. If there is no user port, the network fiber option is SC.

➤ **To calculate optical budget:**

Optical Budget [dB] =
|Receive Sensitivity| – |Optical Power| –3 (Aging) – Connectors/Patch Panels Loss

➤ **To calculate distance:**

Distance = Optical Budget/Maximum Loss

TDMoIP® Operation Modes

E1/T1 operation modes are:

- Unframed E1/T1 over UDP over IP over Ethernet
- Fractional E1/T1 over UDP over IP over Ethernet
- Fractional E1/T1 with CAS over UDP over IP over Ethernet.

ISDN BRI operation modes are:

- NT mode over UDP over IP over Ethernet
- TE mode over UDP over IP over Ethernet.

IPmux-1E with FXS/FXO/E&M operates in fractional E1/T1 with CAS over UDP over IP over Ethernet.

QoS

QoS supports:

- Labeling IP level priority (ToS/Diffserv) for TDMoIP® packets
- VLAN tagging and priority labeling according to IEEE 802.1p&Q for TDMoIP® packets.

The user can configure the ToS (Type of Service) of the outgoing TDMoIP® packets. This allows an en-route Layer 3 router or switch, which supports ToS, to give higher priority to IPmux-1/1E TDMoIP® traffic for delay-sensitive and secure applications. IPmux-1 allows you to configure the **WHOLE** ToS byte field, since different vendors may use different bits to tag packets for traffic prioritization. This also enables operation according to various RFC definitions (for example RFC 2474, RFC 791). The user can also configure VLAN priority bits for Level 2 priority.

Timing

IPmux-1 maintains synchronization between TDM devices by deploying advanced clock distribution mechanisms.

Available timing modes are:

- Loopback
- Adaptive
- Internal clock
- External clock.

Note *For more details, see Timing Modes below.*

Bundle Redundancy

IPmux-1/1E features a bundle redundancy capability. This feature enables the user to backup the TDMoIP® traffic in case of fault at the bundle connection level and/or the TDM level. This feature permits the user to set a different path for the primary bundle and for the secondary bundle (different IP networks, different links, different IPmux units, etc) and thus rely on two routes, which are not influenced by the same faulty IP/Ethernet conditions. The following redundancy modes are supported:

- **1+1**: Both the primary and secondary bundles transmit TDMoIP traffic, but only the active bundle receives TDMoIP traffic, while the redundant bundle ignores the Rx path.
- **1:1**: Only one bundle transmits and receives TDMoIP traffic while the secondary bundle is kept on hold.

1.2 Physical Description

IPmux-1E is a 1U high 19-inch (IPmux-1 is a 1U high 8.5-inch), easy-to-install standalone unit. An optional rack mounting kit option is available.

Figure 1-7 shows a 3-dimensional view of IPmux-1 and IPmux-1E.

Figure 1-7. IPmux-1/1E 3D View

The control interface and indicator LEDs are located on the front panel of IPmux-1/1E. For further details, see *Chapter 3*.

User and network ports and power supply are located on the rear panel of IPmux-1/1E. For further details, see *Chapter 2*.

1.3 Functional Description

IPmux-1/1E provides TDM connectivity across the IP/Ethernet network. A single bundle (group of timeslots) can be transmitted to a predefined far-end bundle. IPmux-1/1E supports ICMP (ping), and generates ARP in case of unknown next hop MAC addresses, answers ARP requests, and supports 802.3 VLAN Ethernet format.

IPmux-1/1E supports a variety of interfaces: E1/T1, ISDN BRI and analog POTs. Traffic is transmitted over the network as E1/T1 or fractional E1/T1, using the TDMoIP® method. IPmux-1/1E supports an Ethernet user port for user LAN connectivity.

Configuration and management are provided via the IPmux-1/1E local terminal, Telnet or RADview management tool (SNMP).

Figure 1-8 shows a typical application for IPmux-1.

Figure 1-8. IPmux-1 E1/T1 Point-to-Point Application

IPmux-1/1E works in conjunction with the rest of the IPmux product line (see *Figure 1-9*). The combination of IPmux products provides up to 31 per E1 or 24 per T1 remote bundles, attached to one central IPmux-4/16 (see *Figure 1-9*).

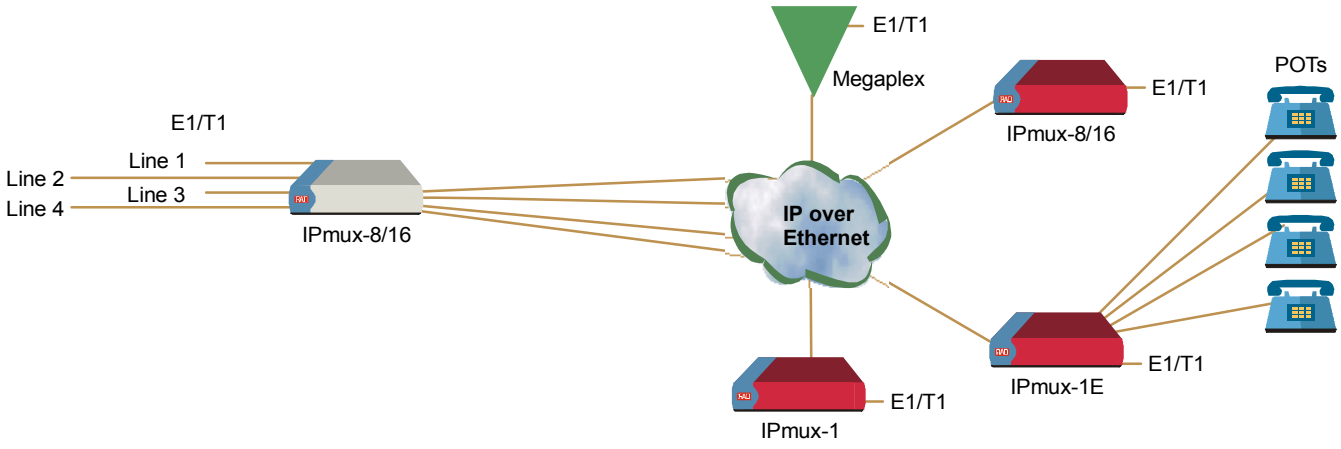

Figure 1-9. Grooming of Timeslots from Remote Sites into a Single E1/T1 Port at Central Site

Other ISDN/FXS/FXO/E&M applications are shown in *Figure 1-3*, *Figure 1-4*, and *Figure 1-5*.

Operation Modes

Static Mode

When the timeslot allocation is static and no activity is detected, the payload can be efficiently encoded using a constant bit rate.

The TDMoIP® payload consists of between one and thirty 48-octet subframes. The number of subframes is pre-configured and typically chosen according to latency and bandwidth constraints.

Dynamic CAS Mode

When timeslots are dynamically allocated, and CAS can be detected for bandwidth conservation, the payload can be efficiently encoded using a variable bit rate.

CESoIP Mode

In general, when the timeslot allocation is static and no activity is detected, the payload can be efficiently encoded using a constant bit rate.

The CESoIP payload size is based on the packetization delay (in msec); the minimum size is 1 msec, and increases in steps of 1 msec.

E1/T1

This section describes the IPmux-1 E1/T1 operation modes, which are:

- Unframed – valid for static and CESoIP/E1
- Fractional – valid only for static and CESoIP
- Fractional with CAS –valid only for static and dynamic CAS .

Unframed (Transparent)

In the transparent mode, the incoming bit stream from each channel (regardless of framing) is converted into IP over Ethernet frames. This option provides clear channel end-to-end service (unframed).

Fractional

In the fractional mode, the incoming bit stream is regarded as a sequence of N × 64 kbps channel groups (according to framing). Each predefined group of channels is converted into a structure block. The structure block is packetized into IP frames and transmitted.

This mode allows transmission of several selected timeslots without the whole E1 or T1 frame, as in transparent mode.

Note *Use Fractional mode when grooming ISDN BRI channels from a remote IPmux-1E unit.*

Fractional with CAS

In the fractional-with-CAS mode, the structure block (as described under Fractional Operation Modes, above) also includes Channel Associated Signaling (CAS). The relevant portion of the signaling channel is packetized and sent to the destination.

Note

Use Fractional with CAS mode when grooming FXS/FXO/E&M channels from a remote IPmux-1E unit.

ISDN BRI

The section describes the IPmux-1E ISDN BRI S-interface operation modes, which are:

- TE mode
- NT mode.

The selected mode applies to all 4 channels. The NT or TE mode is determined by phantom feeding and software setting, which is enabled/disabled by jumpers located on the ISDN BRI card (see *Chapter 2*).

TE Mode

All four channels are configured in TE (Terminal Equipment) as defined in I.430.

NT Mode

All four channels are configured in NT (Network Termination) as defined in I.430. TE Deactivation is not used in NT mode, and Layer 1 is always in active.

Note

If the jumpers enable phantom feeding, the TE mode cannot be selected as the IPmux-1E operation mode. If phantom feeding is disabled, both NT and TE are valid options.

FXS/FXO/E&M

The section describes the FXS/FXO/E&M operation modes, which are:

- E1 mode
- T1-D4 mode
- T1 ESF mode.

The IPmux-1E FXS/FXO/E&M operation modes allow IPmux to work opposite E1, T1-D4, or T1-ESF. Two parameters are set internally when choosing one of the options:

- A-Law/μ-Law
  - A-Law when E1 mode is selected
  - μ-Law is used in PCM CODEC when T1 (D4 or ESF) is selected.
- E1, T1-D4, and T1-ESF with CAS are structured differently in the TDM ↔IP interworking function. A different structure must be used when working opposite each one.

Timeslot Assignment in a Bundle

A bundle is a group of timeslots associated with a specific E1 or T1 channel. IPmux-1/1E places individual or multiple TDM timeslots (up to 31 (E1) or 24 (T1) timeslots) into bundles with a single IP address destination.

ISDN BRI

The timeslot assignment in a bundle for IPmux-1E with ISDN BRI (when working opposite IPmux with E1/T1 or Megaplex) is as follows:

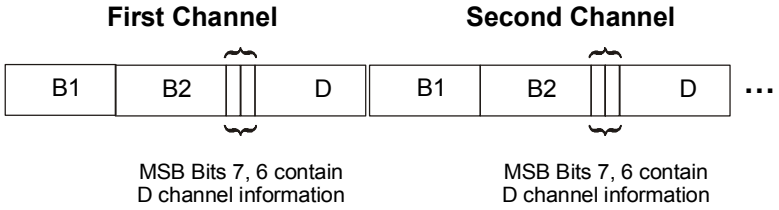

Figure 1-10. Timeslot Assignment in a Bundle, for IPmux-1E/ISDN

As shown in *Figure 1-10*, the four ISDN BRI channels consume 12 timeslots in the bundle. The E1/T1 IPmux should work in framed mode (no CAS).

The three TS groups in the bundle are assigned according to ISDN BRI channel numbers; the first group is assigned to the lowest ISDN BRI channel that is enabled, etc.

FXS/FXO/E&M

The timeslot assignment in a bundle with analog (FXS/FXO/E&M) is straightforward. Each timeslot in a bundle is assigned to a specific analog channel according to analog channel numbers; the first timeslot is assigned to the lowest analog channel that is configured, etc.

Note *The E1/T1 TDMoIP® gateway that works opposite the analog channels should work in* Framed with CAS mode.

Bundle Redundancy

IPmux-1/1E features a bundle redundancy capability. This feature enables the user to backup the TDMoIP® traffic in case of fault at the bundle connection level and/or the TDM level. This feature permits the user to set a different path for the primary bundle and for the secondary bundle (different IP networks, different links, different IPmux units, etc) and thus rely on two routs, which are not influenced by the same faulty IP/Ethernet conditions.

The triggers for the bundle flip are user configurable in terms of number of events and the time period in which the events will be counted. The user can configure thresholds for both the TDM physical error levels and the Bundle connection error level. The first threshold that will be breached will trigger a redundancy flip.

There are two modes of bundle redundancy:

- **1+1** – Both the primary and secondary bundles transmit TDMoIP® traffic, but only the active bundle receives TDMoIP® traffic, while the redundant bundle ignores the Rx path. This mode results in minimum recovery time between the bundles whenever switch/flip occurs, but on the other hand increases the total throughput.
- **1:1** – Only one bundle transmits and receives TDMoIP® traffic while the secondary bundle is kept on hold. This mode does not affect the throughput, however, it increases the recovery time of the system in case switch/flip occurs (depends on the network elements involved in the application). In 1:1 mode, the active and redundant paths are monitored continuously to detect failure and initiate the flip/switch using OAM keep-alive messages.

The following figures illustrate typical bundle redundancy applications.
In *Figure 1-11* IPmux-1 duplicates the incoming TDM traffic internally in order to create a redundant bundle. Each bundle is routed to a different IP/Ethernet/MPLS network.

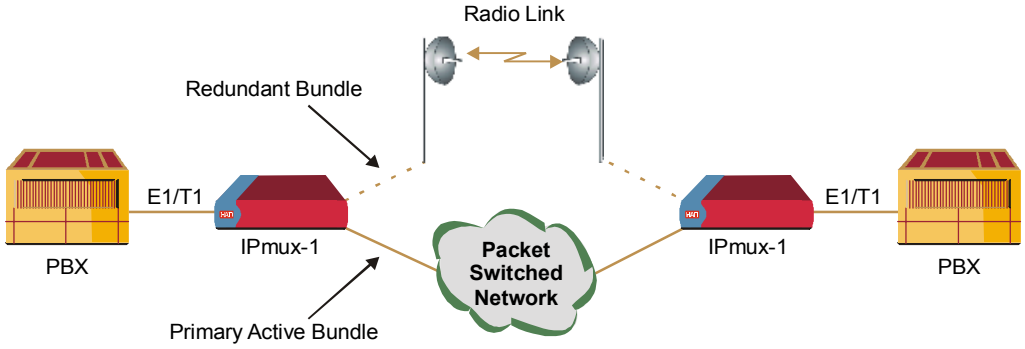

Figure 1-11. Bundle Redundancy Application (A)

In *Figure 1-12* two separate IPmux-1 units are fed with the same E1/T1 stream and provide two bundles. The bundles are routed into two different paths. The remote IPmux-1 is responsible for administering the primary and secondary bundle activities.

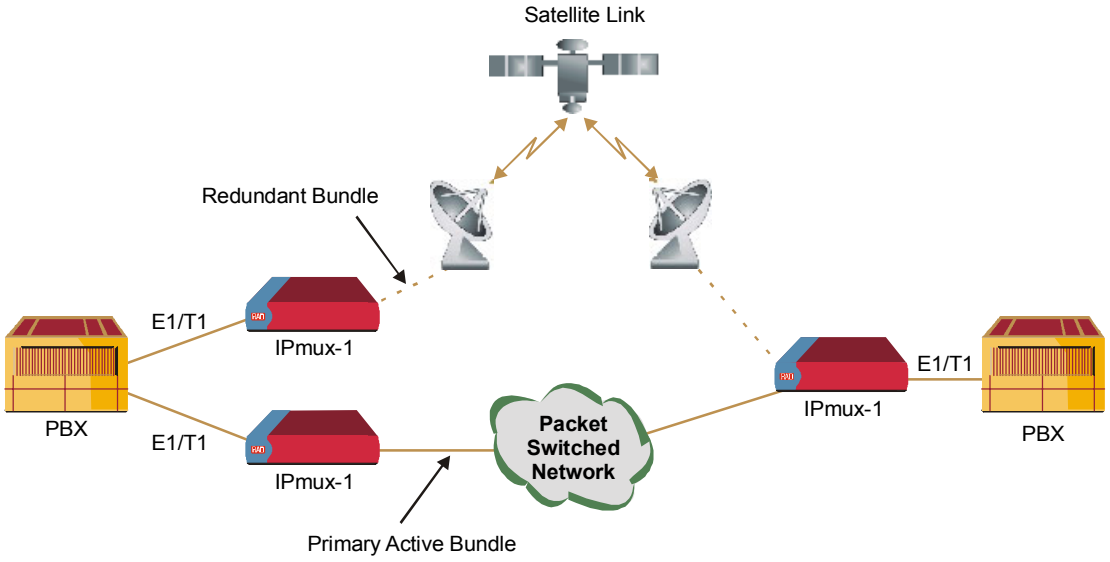

Figure 1-12. Bundle Redundancy Application (B)

Testing

Diagnostic capabilities include E1/T1 or ISDN BRI S local and remote loopback tests for rapid localization of faults. The E1/T1 or ISDN BRI S channel can be looped locally, toward the line, or toward the remote end (see *Chapter 4* for more information). Remote loopback and tone injection are available for the FXS/FXO/E&M port.

Timing Modes

The E1/T1 Tx clock, or ISDN/FXS PCM clock, can operate in several timing modes to provide maximum flexibility for connecting the IPmux-1/1E E1, T1, ISDN or FXS/FXO/E&M channels.

Each of the clocks must be configured correctly on both the receive and transmit ends to ensure proper operation and prevent pattern slips (see *Figure 1-13*, *Figure 1-15*, and *Figure 1-16*).

E1/T1

The E1/T1 available Tx modes are:

- Loopback timing – the E1/T1 Tx clock is derived from the E1/T1 receive (Rx) clock.
- Adaptive timing – in this mode, the E1 or T1 Tx clock is regenerated using the Adaptive method. In this method, the fill level of the buffer receiving packets is monitored. If the buffer begins to overfill, the regenerated Tx clock frequency increases to avoid overflow. If the buffer begins to empty, the Tx clock (toward the TDM device) decreases to avoid underflow.
- Internal clock timing – in this mode, the Tx clock is received from an internal oscillator.
- External clock timing – in this mode the Tx clock is taken from the external clock input (Ordering option). The external clock port also outputs the input clock signal to allow connection to other units, if needed.

Note *In adaptive timing mode the regenerated clock is subject to network Packet Delay Variation and may not comply with jitter and wander specifications.*

ISDN/FXS/FXO/E&M

The available timing modes for the PCM clock are:

- Loopback timing – available only when IPmux-1E ISDN BRI is configured as TE (not available in ISDN BRI NT mode or for FXS/FXO/E&M interface). In this mode the PCM clock is derived from Channel 1. It is recommended not to deactivate Channel 1 while it is in loopback clock so that data will not be damaged. If Channel 1 is disconnected or deactivated (by the NT side), the PCM clock will change to Internal clock and a momentary disruption will occur to the other channels (2, 3, 4), if they are active.
- Adaptive mode – the clock is regenerated using the Adaptive method, where the rate of arriving packets is used to regenerate the clock (see *E1/T1*, above).
- Internal Mode – the clock is received from an internal oscillator.

Network Timing Schemes

The following paragraphs describe typical timing schemes and the correct timing mode settings for achieving end-to-end synchronization.

External Network Timing

When the edges of the network are synchronized by an external network clock source, all the IPmux-1 units should be configured to work in loopback timing mode (see *Figure 1-13*). This topology enables any-to-any connectivity.

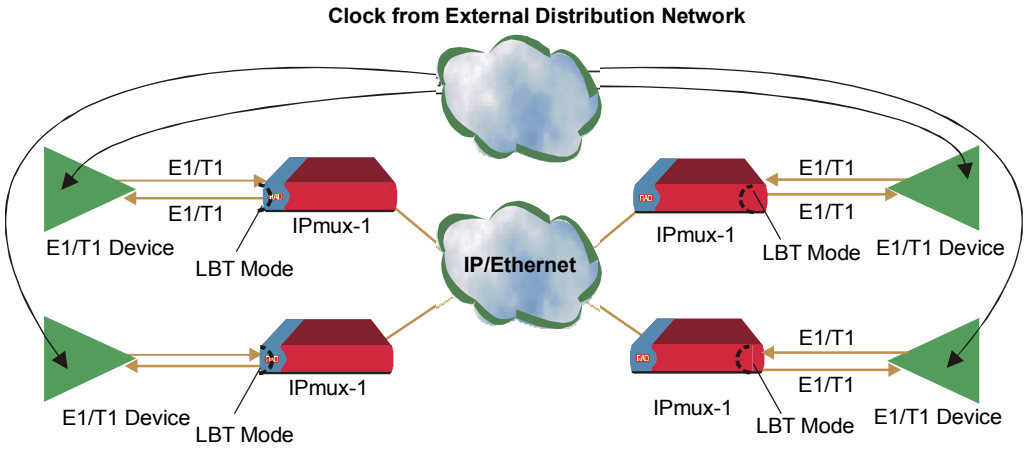

Figure 1-13. IPmux-1 in Loopback Timing Mode

External timing from the network can also be issued to IPmux-1 by External Clock input; in this case, the E1/T1 device will use the LBT mode.

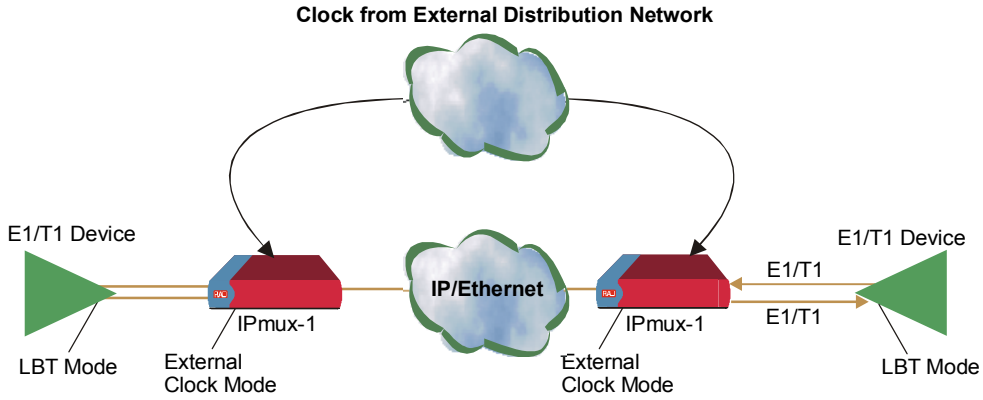

Figure 1-14. IPmux-1 in External Clock Mode

Single Source Clock Network

When a common clock is not available on all the ends of the network one of the IPmux-1 devices is configured to work in Loopback timing mode, while the other IPmux-1 device is configured to work in Adaptive timing mode (see *Figure 1-15*).

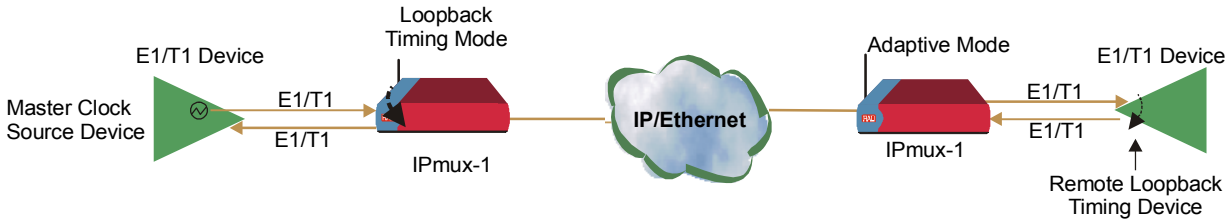

Figure 1-15. IPmux-1 in Adaptive Timing Mode

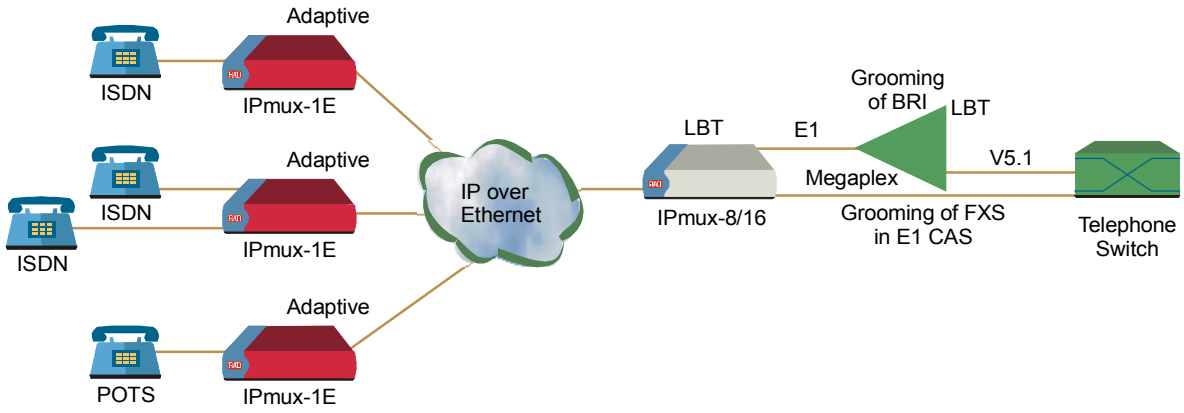

Figure 1-16. IPmux-1E in Adaptive Timing Mode

Note *Megaplex can also be connected directly to the network, via its TDMoIP® main link (ML-IP).*

Frame Format

The Ethernet frame sent by the IPmux-1 is a UDP datagram that transfers E1/T1 payload bytes over IP over Ethernet (UDP payload + UDP header + IP header + Ethernet header). The UDP payload size depends on the connection mode:

- **Static mode:** The UDP payload size is equal to TDM bytes per frame (TDM bytes/frame configuration).
- **Dynamic CAS mode:** The maximum UDP payload size depends on the number of configured time slots and is equal to:

  $[(TS_A + 4) \times (\text{number of configured timeslots})] + 4]$

  where TS_A = Active timeslot bytes in frame

Note *Active timeslot bytes in frame are the number of bytes per timeslot that are passed per Ethernet frame.*

An Active timeslot is one where a call is detected by monitoring CAS.

  The UDP payload size is not fixed–it depends on the number of active time slots:

  $[(TS_A + 4) \times (\text{number of active timeslots})] + 4]$

- **CESoIP mode:** The UDP payload size is equal to:

  [(Configured Packet Delay) x (number of configured timeslots) x 8] + 12

Table 1-2 specifies the structure of the different headers, special fields, and the payload in the Ethernet packet.

Figure 1-17. TDMoIP® Frame Structure

Table 1-2. Ethernet Frame Structure

	Field length (bytes)	Field	
MAC Layer	7	Preamble	
	1	SFD	
	6	Destination MAC Address	
	6	Source MAC Address	
LLC Layer	2	Type	***Note:*** *IEEE 802.1p&q VLAN Tagging (additional 4 bytes if enabled)*
IP Layer	1	Vers/HLEN	
	1	Service Type	
	2	Total Length	
	2	Identification	
	1	Flags/Fragment Offset (most)	
	1	Fragment Offset (least)	
	1	Time to Live	
	1	Protocol	
	2	Header Checksum	
	4	Source IP Address	
	4	Destination IP Address	
UDP Layer	2	UDP Source Port	***Note***: *The UDP source port field is used to transfer the destination bundle number in static and dynamic CAS modes.*
	2	UDP Destination Port	
	2	UDP Message Length	
	2	UDP Checksum	
Data Layer	...	Payload	
MAC Layer	4	CRC	

VLAN Support

VLAN, according to IEEE 802.1p&Q, adds four bytes to the MAC layer of the Ethernet frame. The user can set the contents of these bytes, MAC layer priority and VLAN ID. In this mode, only VLAN format frames are sent and received by IPmux-1. *Figure 1-18* shows the VLAN tag format.

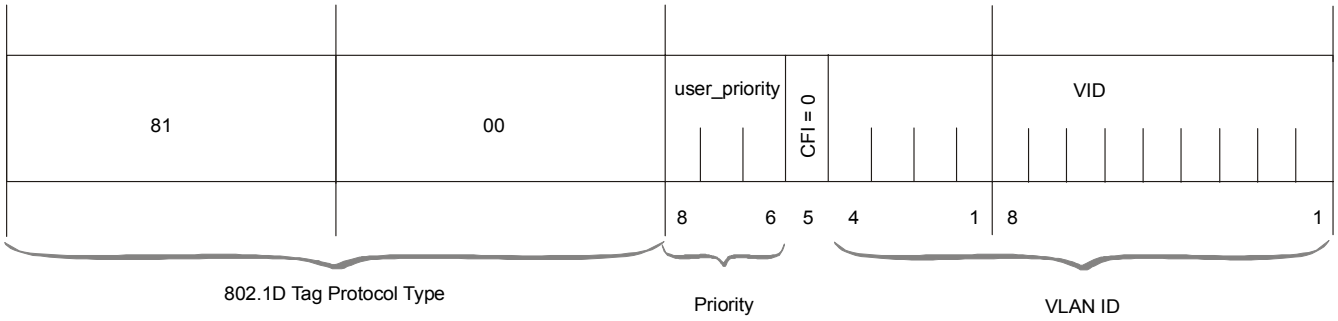

Figure 1-18. VLAN Tag Format (802.1p&Q)

UDP Support

Table 1-3. UDP Ports Definition

Field Length (Bits)	Field Description	Value	Function
2 bytes	UDP Source Port	2–497d*	Destination timeslots bundle
2 bytes	UDP Destination Port	2142d	Standard TDMoIP® UDP port

* The MSB of this field can be either 1 or 0 for inband end-to-end proprietary signaling.

Note *The UDP Source Port field is used for destination timeslots bundle indication. For example, if the destination is: Bundle 1 – 02, Bundle 2 – 03, Bundle 3 – 04, Bundle 4 – 05, etc.*

For more information about VLAN tagging, refer to *IEEE 802.1p&Q*.

Packet Delay Variation

Packets are transmitted at set intervals. Packet Delay Variation is the maximum deviation from the nominal time the packets are expected to arrive at the far end device. IPmux-1 has a buffer that compensates for the deviation from the expected packet arrival time to prevent IPmux-1 buffers from emptying out or overflowing.

Packet Delay Variation is an important network parameter. Large PDV (exceeding the jitter buffer configuration) will cause receive buffer underflows and errors at the TDM level (see *Figure 1-19*).

To compensate for large PDV, configure the PDVT (jitter) buffer to a higher value.

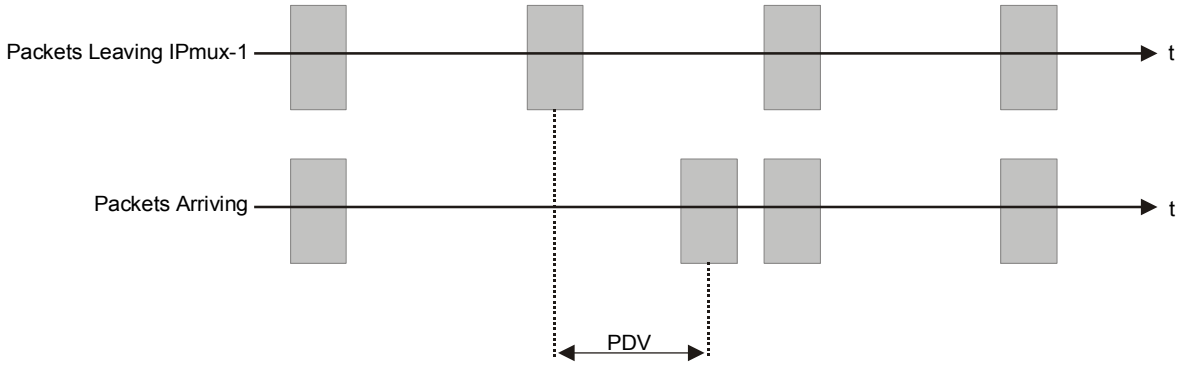

Figure 1-19. Packet Delay Variation

PDVT (Jitter) Buffer

IPmux-1 is equipped with a Packet DVT (Delay Variation Tolerance) buffer. The PDVT buffer or jitter buffer is filled by the incoming IP packets and emptied out to fill the TDM stream. The buffer begins to empty out only after it is half full in order to compensate for packet starvation from the Ethernet side. The time it takes for half of the buffer to empty out is the maximum DVT time. Delay Variation Tolerance is configurable. The PDVT (jitter) buffer is designed to compensate for packet delay variation caused by the network + intrinsic PDV.
It supports a delay variation of up to 300 ms for E1 or T1 in static or dynamic CAS modes, and up to 127 ms in CESoIP mode.

PDVT Buffer Effect on Delay

The PDVT buffer is on the TDM path; it adds to the total end-to-end delay (see delay calculation, below).

Intrinsic PDV in Static Mode

If TDM bytes/frame is greater than 48, there is an intrinsic delay variation (intrinsic PDV). The intrinsic PDV introduced by the module is a function of n>1 in TDM bytes/frame configuration as follows:

I.PDV (ms) = [(n-1) x 1000) / (frames per second × n]

$$\text{where } n = \frac{\text{Configured TDM bytes/frame}}{48} \quad (n = 1 \text{ to } 8).$$

➤ **To configure jitter buffer depth:**

The estimated or measured PDV introduced by the network + intrinsic PDV (if it exists) introduced by the module as a result of configuring the TDM bytes / frame > 48.

Note *For a bundle that contains a few timeslots (i.e. 1 to 3) the minimal jitter buffer should be 6 ms.*

Intrinsic PDV in Dynamic CAS Mode

I.PDV (ms) = active time slot bytes in frame X 0.125

Active timeslot bytes in frame is the number of bytes per active time slot that will be sent on every frame transmitted over the Ethernet.

Intrinsic PDV in CESoIP Mode

The value of the packet delay configuration is user-defined.

Ethernet Throughput

Increasing payload size reduces the ratio of the TDMoIP header segment in the packet, thus significantly reducing the total Ethernet throughput.

On the other hand, packetization delay and intrinsic packet delay variation (PDVT) are increased; this contributes to a higher end-to-end delay. This effect can be small and negligible when a full E1 (or many timeslots) are transferred, but can be very significant when few timeslots are transferred. In this case, the packetization delay and the intrinsic PDV when configuring a large value of TDM bytes/frame can be very large and may exceed the maximum PDVT (jitter) buffer on the receiving end.

Ethernet Throughput in Static Mode

Configuring the TDM bytes per frame (TDM bytes/frame) parameter can reduce Ethernet throughput (bandwidth or traffic traveling through the Ethernet). This parameter controls the number of TDM bytes encapsulated in one frame.

The TDM bytes/frame parameter can be configured to n x 48 bytes where n is an integer between 1 and 30.

➤ **To calculate Ethernet throughput and intrinsic PDV as a function of TDM bytes/frame:**

Ethernet load (bps) =
[(frame overhead (bytes) + TDM bytes/frame) x 8] x frames/second

Frame overhead = Ethernet overhead + IP overhead = 46 bytes

Note *The frame overhead does not include:*

- *Preamble field: 7 bytes*
- *SFD field: 1 byte*
- *Interframe gap: 12 bytes*
- *VLAN field (when used): 4 bytes.*

Frame/second =

Unframed: 5447/**n** for a full E1

4107/**n** for a full T1

Framed: 8000 x **k**/(46.875 x n)

Where **k** = number of assigned timeslots

Where **n** = $\frac{\text{TDM bytes/frame}}{48}$

The maximum Ethernet throughput in static mode is calculated by:

Unstructured

$$\underbrace{(\mathbf{VLAN} + \mathbf{frame\ overhead} + \mathbf{payload})}_{\text{frame size}} * \left\{ \frac{\overbrace{8000 * TS}^{\text{data}}}{47 * n} \right\} * 8\,\text{bits}$$

Structured

$$\underbrace{(\mathbf{VLAN} + \mathbf{frame\ overhead} + \mathbf{payload})}_{\text{frame size}} * \left\{ \frac{\overbrace{8000 * TS}^{\text{data}} + \overbrace{\frac{8000 * \mathbf{TS}}{(47 * 8) - 1}}^{\text{pointer}} + \overbrace{500 * \left\lceil \frac{\mathbf{TS}}{2} \right\rceil}^{\mathbf{CAS}}}{47 * n} \right\} * 8\,\text{bits}$$

- where **VLAN** is an optional field: if enabled it adds 4 bytes to the frame overhead
- where **payload** = number of TDM bytes in frame, (48, 96, 144, 192, … 384)
- where **frame overhead** = size of 46 bytes, include MAC, LLC, IP and UDP layer
- where **CAS** is signaling (note: for structured mode only)
- where **TS** is number of configured time slots.

The result in both the equations is in bits per second [bps].

Ethernet Throughput in Dynamic CAS Mode

Configuring the active time slot bytes parameter can reduce Ethernet throughput. This parameter controls the number of TCM bytes encapsulated per time slot in a frame. The range is 24 to 64 bytes.

A large number of time slots and a large active time slot bytes size can surpass the maximum Ethernet frame size.

In dynamic CAS mode the throughput is variable, depending on the active time slots as defined by the ABCD CAS bits.

The maximum Ethernet throughput in dynamic CAS mode is calculated by:

$$[(\frac{8000}{\textbf{payload}}) \times ((\textbf{payload} + 4) \times \textbf{TS}) + 4 + \textbf{frame overhead}] \times 8 \text{ bits}$$

- where **frame overhead** is 46 bytes, including MAC, LLC, IP, and UFP layers
- where **TS** = number of configured time slots
- where **payload** = number of active time slot bytes per frame (24 to 64)

Note

The frame overhead does not include:

- *Preamble field: 7 bytes*
- *SFD field: 1 byte*
- *Interframe gap: 12 bytes*
- *VLAN field (when used): 4 bytes*.

Ethernet Throughput in CESoIP Mode

Configuring the packet delay and the number of time slots controls the Ethernet throughput. The range of the packet delay is 3 to 127 msec.

A large number of time slots and a long packet delay can surpass the maximum Ethernet frame size.

The maximum Ethernet throughput in CESoIP mode is calculated by:

$$[(\frac{1000}{\textbf{packet delay}}) \times ((\frac{\textbf{packet delay}}{8}) \times \textbf{TS}) + 12 + \textbf{frame overhead}] \times 8 \text{ bits}$$

- where **frame overhead** is 46 bytes, including MAC, LLC, IP, and UFP layers
- where **TS** = number of configured time slots:
  - for an unframed E1 interface = 32
  - for an unframed E1 interface = 24
- where **packet delay** = 3 to 127.

Round Trip Delay

The voice path round-trip delay is a function of all connections and network parameters. The calculation for E1/T1 in each connection mode is described in the following sections.

Round Trip Delay in Static Mode

$$(\pm 2\ \mu s)\ RTDelay_{(\mu s)} = 2 \times [\frac{47 \times \mathbf{n}}{\mathbf{NTS}} \times 125\ \mu s + \text{PDVT buffer}\ \mu s + 1000\ \mu s] + \text{network round trip delay}$$

- where $\mathbf{n} = \frac{\text{TDM bytes/frame}}{48}$
- where **NTS** = number of timeslots assigned; in unframed mode NTS is constant: 32 for E1, 24 for T1

Round Trip Delay in Dynamic CAS Mode

$$RTDelay_{(\mu s)} = 2 \times [\frac{8000000}{\mathbf{payload}} + \text{PDVT buffer}\ \mu s + 1000\ \mu s] + \text{network round trip delay}$$

- where **payload** = number of active time slot bytes per frame (24 to 64)

Packet Delay in CESoIP Mode

$$RTDelay_{(\mu s)} = 2 \times [\mathbf{packet\ delay} + \text{PDVT buffer}\ (\mu s) + 1000\ \mu s] + \text{network round trip delay}$$

- where **packet delay** is a configuration parameter

Reorder and Duplication of Ethernet Frames

IPmux-1/1E handles situations in the IP network where:

- Packets are reordered by the network
- Packets are duplicated.

Static Mode

Reordering Frames

The ability to correct problems of reordering is only supported for odd values of payload, i.e. 1, 3, 5, 7, …, 29.

You can reorder up to seven frames; the number depends on the number of TDM bytes/frame size and buffer size.

The number of frames that can be reordered is calculated by:

$$\frac{(\text{jitterbuffer[msec]} - 1)(\text{Ts} \times 8)}{47 \times \text{payload}}$$

- where **Ts** = number of timeslots
- where **payload** = number of TDM bytes in frame, i.e. 1, 3, 5, 7, …, 29.

Note *The maximum number of frames that can be reordered is seven, even if your calculation > 7.*

Duplicated Frames

When frames are duplicated, IPmux-1/1E only uses the later frame.

Dynamic CAS Mode

Reordering and duplication of frames is not supported; the frames pass to the TDM side without any modification.

CESoIP Mode

The number of frames that are reordered depends on the frame delay and the jitter buffer size.

The number of frames that can be reordered is calculated by:

$$\frac{\text{jitterbuffersize[msec[}}{\text{framedelay[msec]}}$$

OAM Connectivity

When a destination IPmux is lost, the traffic load that is transmitted to that IPmux is significantly decreased (several packets per second per connection). The IPmux starts transmitting at full rate only when it detects an IPmux at the remote side.

OAM Connectivity is used to detect a valid connection (the remote IPmux will confirm it recognizes the connection and that it is enabled). It prevents flooding by a handshake.

The control packets are run over a unique bundle number that is used for this purpose. The control packets have the same VLAN ID and TOS of the originating connection. The control packet uses the TDMoIP® UDP number.

OAM connectivity can be enabled or disabled.

Note *For control packets, the UDP check sum is not calculated nor checked.*

End-to-End Alarm Generation

An end-to-end alarm generation mechanism exists in IPmux-1 to facilitate the following alarms:

- Unframed – AIS is transmitted toward the near-end PBX in event of:
  - Far-end LOS, AIS
  - PDVT underflow/overflow.
- Framed – Timeslot/CAS configurable alarm pattern is transmitted toward the near-end PBX in event of:
  - Far-end LOS, LOF, AIS
  - PDVT underflow/overflow.

VLAN Traffic Behavior

Table 1-4 lists the IP and VLAN validity checks that are performed with each Ethernet packet that is received by IPmux1/1E.

Table 1-4. VLAN Check for Packets that are Received by IPmux-1/1E

Packet Type	Source IP Check	VLAN Check
Management	Performed	Performed
TDM over IP	Performed	Performed
Receiving Ping	Not performed	Not performed, even if it is one of the IPs that is configured for the manager or for the connection
ARP	Not performed	
Telnet	Performed only when Telnet access mark is from manager	Performed only when Telnet access mark is from manager

Table 1-5 lists the IP and VLAN validity checks that are performed with each Ethernet packet that is sent by IPmux1/1E.

Table 1-5. VLAN Check for Packets that are Sent by IPmux-1/1E

Packet Type	VLAN Support
Management	As configured for the manager
TDM over IP	As configured for the connection
Answer to Ping	If the IPmux-1/1E received the packet with VLAN tagging: the IPmux-1/1E replies with the same VLAN ID (even if it's one of IPs that is configured for the manager or for the connection) If the IPmux-1/1E received the packet without VLAN tagging: if it's one of the IPs that is configured for the manager or for the connection, the IPmux-1/1E replies with the VLAN ID that is in the manager or connection configuration
ARP initiated by us	No VLAN value unless it is to one of the managers or the connection's IP address
Telnet	
Ping initiated by us	

Ethernet User Port

The Ethernet user port allows a user to aggregate both TDMoIP® traffic and his private network LAN traffic to a single Ethernet network connection without requiring an access switch. This is a cost effective solution for MTU or small office applications. A rate limiter to restrict user port traffic is supported.

IPmux-1/1E contains an internal switch where one of its ports is connected to a TDMoIP® interworking function, another external switch port is used as the user port, and the third is used as an Ethernet network port.

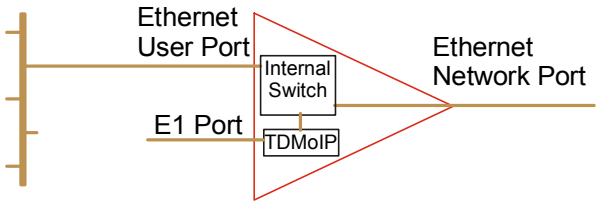

Figure 1-20. IPmux-1/1E with Ethernet User Port

Note *Priority is always given to TDMoIP® packets inside the internal switch.*

Internal Switch Operation Modes

IPmux-1/1E offers a user LAN port in addition to the LAN port on the network side. The device performs switching at level 2. The switch supports both transparent bridging and VLAN-aware bridging. The switch supports rate limiting of traffic going from the user port to the network port. It supports up to 12K MAC addresses (depending on their values and the order in which they are learned).

The switch modes are described later in this section. They are:

- Basic mode
- User Tagged mode
- User Untagged mode
- Rate mode
- Rate + User Tagged mode.
- Rate + User Untagged mode.

Rate Limiter Option

In this option a rate limiter is available to limit user port traffic. This feature is valuable when a limited bandwidth DSL modem, for example, is used to extend the Ethernet link (generally when the Ethernet link rate is limited/shaped to a lower rate after IPmux). In this case TDMoIP® packets will be dropped in the modem even if it was prioritized at the IPmux internal switch. This is prevented by limiting the user port to actual link rate minus TDMoIP® bandwidth. The rate limiter can limit user traffic at 50 kbps steps up to 5 Mbps and in 1 Mbps steps from 5 Mbps to 100 Mbps.

Note *Access to the IPmux host for management is possible only from the network port.*

Switch Behavior

Use *Table 1-6* to determine the operation mode.

Table 1-6. Switch Behavior

Network VLAN Tagging	User VLAN Tagging	Rate Limit	
		Rate Limit>0	**Rate Limit=0** (Disable)
Disable	Disable	Rate Mode (see *Table 1-10*)	Basic Mode (see *Table 1-7*)
Enable	Disable	Rate+User Untagged Mode (see *Table 1-12*)	User Untagged Mode (see *Table 1-9*)
Enable	Enable	Rate+User Tagged Mode (see *Table 1-11*)	User Tagged Mode (see *Table 1-8*)

Basic Mode

Features:

- Network port learning is based on MAC
- User port learning is based on MAC
- TDMoIP® & Managers traffic is tagged or untagged.

Table 1-7. Basic Mode

Frame Action	Switch Action
A tagged frame enters the Network port	Switched to User port without changing the frame*
A tagged frame enters the User port	Switched to Network port without changing the frame*
An untagged frame enters the Network port**	Switched to User port without changing the frame*
An untagged frame enters the User port**	Switched to Network port without changing the frame*

Notes

* *The switch may decide not to pass the frame to the other port, based on its learning.*

** *A priority-tagged frame (frame with a tag and VLAN-ID 0) is treated just like an untagged frame. This includes rewriting the priority field with 0.*

User Tagged Mode

Features:

- Network port learning is based on MAC+VLAN
- User port learning is based on MAC+VLAN
- TDMoIP® & manager traffic must be tagged.

Table 1-8. User Tagged Mode

Frame Action	Switch Action
A tagged frame enters the network port	
Both user and network ports are members of frame's VLAN	Switched to user port without changing the frame*
Either the user or network port is not a member of frame's VLAN	Discarded
A tagged frame enters the user port	
Both user and network port are members of frame's VLAN	Switched to network port without changing the frame*
Either the user or network port is not a member of frame's VLAN	Discarded
An untagged frame enters the network port (see Note 2)	
Both user and network ports are members of the network port default VLAN	Switched to user port* Default network port VLAN ID is added with priority 0
Either the user or network port is not a member of the network port default VLAN	Discarded
An untagged frame enters the user port**	
Both user and network ports are members of the user port default VLAN	Switched to network port* Default user port VLAN ID is added with priority 0
Either the user or network port is not a member of the User port default VLAN	Discarded

Notes

* *The switch may decide not to pass the frame to the other port, based on its learning.*

** *A priority-tagged frame (frame with a tag and VLAN-ID 0) is treated just like an untagged frame. This includes rewriting the priority field with 0.*

User Untagged Mode

Features:

- Network port learning is based on MAC+VLAN
- User port learning is based on MAC+VLAN
- TDMoIP® & manager traffic must be tagged.

Table 1-9. User Untagged Mode

Frame Action	Switch Action
A tagged frame enters the network port	
Both user and network ports are members of frame's VLAN	Switched to user port*, and the tag is removed
Either the user or network port is not a member of frame's VLAN	Discarded
A tagged frame enters the user port	
Both user and network port are members of frame's VLAN	Switched to network port without changing the frame*
Either the user or network port is not a member of frame's VLAN	Discarded
An untagged frame enters the network port (see Note 2)	
Both user and network ports are members of the network port default VLAN	Switched to user port without changing the frame*
Either the user or network port is not a member of the network port default VLAN	Discarded
An untagged frame enters the user port**	
Both user and network ports are members of the user port default VLAN	Switched to network port* Default user port VLAN ID is added with priority 0
Either the user or network port is not a member of the user port default VLAN	Discarded

Notes

* *The switch may decide not to pass the frame to the other port, based on its learning.*

** *A priority-tagged frame (frame with a tag and VLAN-ID 0) is treated just like an untagged frame. This includes rewriting the priority field with 0.*

Rate Mode

Features:

- There is no network port learning
- User port learning is based on MAC
- TDMoIP® & manager traffic are tagged or untagged.

Table 1-10. Rate Mode

Frame Action	Switch Action
A tagged frame enters the network port	Switched to user port without changing the frame***
A tagged frame enters the user port	Switched to network port without changing the frame* Subject to rate limiting
An untagged frame enters the network port	Switched to user port without changing the frame***
An untagged frame enters the user port	Switched to network port without changing the frame* Subject to rate limiting

Note

* *The switch may decide not to pass the frame to the other port, based on its learning.*

** *A priority-tagged frame (frame with a tag and VLAN-ID 0) is treated just like an untagged frame. This includes rewriting the priority field with 0.*

** *Learning is disabled; therefore, every frame is switched. The network port is typically connected to another switch.*

Rate + User Tagged Mode

Features:

- No network port learning
- User port learning is based on MAC
- TDMoIP® & manager traffic must be tagged.

Table 1-11. Rate+User Tagged Mode

Frame Action	Switch Action
A tagged frame enters the network port	Switched to user port without changing the frame***
A tagged frame enters the user port	
Both user and network ports are members of frames's VLAN	Switched to network port without changing the frame* Subject to rate limiting
Either the user or network port is not a member of frames's VLAN	Discarded
An untagged frame enters the network port	Switched to user port without changing the frame***
An untagged frame enters the user port**	Discarded

Note

* *The switch may decide not to pass the frame to the other port, based on its learning.*

** *A priority-tagged frame (frame with a tag and VLAN-ID 0) is treated just like an untagged frame. This includes rewriting the priority field with 0.*

*** *Learning is disabled; therefore, every frame is switched. The network port is typically connected to another switch.*

Rate + User Untagged Mode

Features:

- Network port learning is based on MAC + VLAN number
- User port learning is based on MAC + VLAN number
- TDMoIP® & manager traffic must be tagged.

Table 1-12. Rate+User Untagged Mode

Frame Action	Switch Action
A tagged frame enters the network port	
Both user and network ports members of frame's VLAN	Switched to user port*, and tag is removed
Either the user or network port is not a member of frames's VLAN	Discarded
A tagged frame enters the user port	Discarded
An untagged frame enters the network port (see Note 2)	
Both user and network ports are members of port Network port default VLAN	Switched to user port without changing (see Note 1)
Either user or network port is not a member of the network port default VLAN	Discarded
A untagged frame enters the user port**	
Both user and network ports members of User port default VLAN	Switched to network port* Subject to rate limiting Default user port VLAN ID is added with priority 0
Either user or network port not member of User port default VLAN	Discarded

Notes

* *The switch may decide not to pass the frame to the other port, based on its learning.*

** *A priority-tagged frame (frame with a tag and VLAN-ID 0) is treated just like an untagged frame. This includes rewriting the priority field with 0.*

DHCP

Dynamic Host Configuration Protocol (DHCP) is a TCP/IP protocol that enables PCs and workstations to get temporary or permanent IP Addresses (out of a pool) from centrally administered servers. DHCP is based on RFC 1531 and RFC 1533.

Lease Length

You can request an IP Address for an infinite period of time (Infinite Lease); however, you must accept the time period that is determined by the server, even if it is different from what you requested.

Manager Option

The server may send IPmux-1/1E a Manager configuration via the DHCP option field:

- Manager IP – Option 200 (type IP Address)
- VLAN ID – Option 201 (type long)
- VLAN Priority – Option 202 (type byte).

When IPmux-1/1E requests a Manager configuration from the server, there may be many replies. The device accepts the offer that includes a Manager Option.

If the reply does not include a Manager Option, IPmux-1/1E waits three seconds for another reply from the server. If no replies have Manager Option, the device accepts the first offer.

1.4 Technical Specifications

E1 Port	*Compliance*	ITU-T Rec. G.703, G.706, G.732, G.823
	Connector	Balanced: RJ-45 8-pin Unbalanced: RJ-45 75Ω (comes with an external adapter cable from RJ-45 to two BNC)
	Data Rate	2.048 Mbps
	Line Code	HDB3
	Line Impedance	Balanced: 120Ω; Unbalanced: 75Ω
	Signal Levels	Receive: 0 to -32 dB with LTU 0 to -10 dB without LTU Transmit Balanced: ±3V ±10% Transmit Unbalanced: ±2.37V ±10%
	Jitter Performance	ITU-T G.823 standard
	External Adapter Cable	TBNC to BNC required
E1 Framing	*Compliance*	G.704, G.706
	Framing	Unframed, CRC4 MF, CAS MF
	Signaling	CAS, CCS (transparent)

T1 Port	*Compliance*	ANSI T1.403, ITU-T Rec. G.703, G.704
	Connector	RJ-45, 8-pin
	Data Rate	1.544 Mbps
	Line Code	B8ZS, B7ZS, AMI
	Line Impedance	100Ω, balanced
	Signal Levels	Receive: 0 to -30 dB Transmit: 0 dB, -7.5 dB, -15 dB, -22.5 dB, with CSU ±2.7V ±10%, adjustable, measured in range 0 to 655 feet, without CSU
	Jitter Performance	AT&T TR-62411, G.824 standards
T1 Framing	*Compliance*	ANSI T1.403
	Framing	Passthrough, SF, ESF
	Signaling	CAS (bit robbing), CCS (transparent)
Local Terminal and Control Interface		DB-9, female
	Mode	RS-232/V.24 (DCE)
	Baud Rate	9.6, 19.2, 38.4, 57.6, 115.2 kbps
	Connector	DB-9
Ethernet	*Compliance*	IEEE 802.3, 802.3u, Ethernet, 802.1p&Q
	Connector	UTP: RJ-45, 8-pin Fiber: SC (without user port), LC (network port when with optional user port is present)
	Ports	1 or 2 (if optional user port is used)
	Data Rate	UTP: 10 Mbps or 100 Mbps, full or half-duplex Fiber: 100 Mbps full-duplex
	Range	Up to 100m on UTP Category 5 cables For optical interfaces: see optical budget calculation (*Table 1-1*)
Analog Voice	*Number of Voice Channels*	4
	Modulation Method	PCM (per ITU-T G.711 and AT&T PUB-43801) μ-Law or A-Law

	Interfaces	FXS: Loop start for direct connection to a 2-wire telephone Nominal level: 0 dBm Nominal impedance: 600Ω Return loss (ERL): Better than 20 dB Frequency response: (Ref: 1020 Hz) • ±0.5 dB, 300 TO 3000 Hz • ±1.1 dB, 250 to 3400 Hz Signal to total distortion, G.712, G.713 method 2: • 0 to -30 dBm0, better than 33 dB • +3 to -45 dBm0, better than 22 dB Idle channel noise: Better than -70 dBm0 (+20 dBrnc) Transformer isolation: 1500 VRMS Ringing - 22 Hz, sine wave
	Diagnostics	Remote analog loopback towards the remote side, activated from local side 1 kHz tone injection towards analog side activity indicators
ISDN S0 Interface	*Number of Ports*	4
	Compliance	ETS 300012, I.430, NTT, 5ESS, DMS-100, NI1
	Bit Rate	192 kbps
	Line Coding	Pseudo-ternary
	Line Termination	100Ω ± 5%
	Connector	RJ-45
Echo Canceller	*Compliance*	G.168 8 ms tail support
External Clock		
E1	*Compliance*	ITUa-T Rec. G.703, G.706, G.732, G.823
	Connector	Balanced: RJ-45 8-pin Unbalanced: TBNC 75Ω (an external adapter cable from TBNC to BNC is required)
	Data Rate	2.048 Mbps
	Line Code	HDB3
	Line Impedance	Balanced: 120Ω; Unbalanced: 75Ω

	Signal Levels	Receive: 0 to -10 dB Transmit balanced: ±3V ±10% Transmit unbalanced: ±2.37V ±10%	
	Jitter Performance	ITU-T G.823 standard	
	External Adapter Cable	TBNC to BNC required	
T1	*Compliance*	ANSI T1.403, ITU-T Rec. G.703, G.704	
	Connector	RJ-45, 8-pin	
	Data Rate	1.544 Mbps	
	Line Code	B8ZS, B7ZS, AMI	
	Line Impedance	Balanced: 100Ω	
	Signal Levels	Receive: 0 to -10 dB Transmit: ±2.75V ±10% at 0 to 655 ft with DSU	
	Jitter Performance	AT&T TR-62411, G.824 standards	
Indicators	*General*	PWR	ON – power supply is OK OFF – malfunction detected
		RDY	ON – self-test is successfully completed OFF – self-test in progress BLINKS – self-test failure
	Ethernet Port	LINK	OFF – line is not active ON – line is OK
		ACT	OFF – no activity ON – a frame is being transmitted or received on the line
		100M	OFF – 10 MHz ON – 100 MHz
		FDX	OFF – half-duplex ON – full-duplex
	E1/T1 Port	SYNC	ON – port is synchronized (no alarm) OFF – signal loss, LOF or AIS is detected (local alarm) BLINKS – RDI detected (remote alarm)
	ISDN Port	SYNC	ON – ISDN BRI frame is synchronized (no alarm) OFF – signal loss, LOF is detected
	FXS Port	SYNC	ON – off-hook OFF – on-hook BLINKS – ringing
		Note: All LEDs are green and ON after power-up.	

Power	*AC Source*	100 to 240 VAC, 50 or 60 Hz
	DC Source	IPmux-1: -36 to -72 VDC (-48 VDC nominal) IPmux-1E: -48 VDC only
	Power Consumption	IPmux-1: 4W IPmux-1 (with Ethernet switch): 10W IPmux-1E: 25W IPmux-1E (with Ethernet switch): 32W
Physical	***IPmux-1***	
	Height	43 mm / 1.7 in
	Width	215 mm / 8.4 in
	Depth	246 mm / 9.7 in
	Weight	1.2 kg / 2.7 lb
	IPmux-1E	
	Height	44 mm / 1.7 in (1U)
	Width	432 mm / 17.0 in
	Depth	246 mm / 9.5 in
	Weight	2.3 kg / 5.1 lb
Environment	*Temperature*	0 to 50°C/32 to 122°F
	Humidity	Up to 90%, non-condensing

Chapter 2
Installation

IPmux-1/1E is delivered completely assembled for bench-top installation. The only mechanical installation procedures that may be necessary are optional installation in a 19-inch rack. For rack installation instructions, refer to the guide that comes with the RM kit.

After installing the unit, configure IPmux-1/1E using an ASCII terminal connected to the IPmux-1/1E control port, or Telnet or RADview TDMoIP® management application. The IPmux-1/1E configuration procedures are described in *Chapter 3* and *Appendix E* of this manual. Configuration parameters are explained in *Appendix E*.

If problems are encountered, refer to *Chapter 4* for test and diagnostics instructions.

Warning

No internal settings, adjustment, maintenance and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.
Always observe standard safety precautions during installation, operation, and maintenance of this product.

2.1 Site Requirements and Prerequisites

Install AC-powered IPmux-1/1E units within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing the required supply voltage, in the range of 100 to 240 VAC.

DC-powered IPmux-1/1E units require a -48 VDC power source. The positive pole can be earthed.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A.

Caution

The DC power source must be isolated from the mains supply by double or reinforced insulation. A suitable fuse or a circuit breaker (16A) should be integrated in the negative power-supply line.

Allow at least 90 cm (36 inches) of frontal clearance for operator access. Allow at least 10 cm (4 inches) clearance at the rear of the unit for cable connections. Make sure that the ventilation holes are not blocked.

The ambient operating temperature of IPmux-1/1E is 0 to 50° C (32 to 122° F), at a relative humidity of up to 90%, non-condensing.

2.2 Package Contents

The IPmux-1/1E package contains the following items:

- IPmux-1/1E unit
- Technical documentation CD
- AC power cord or DC power supply connector kit
- Kit containing hardware for mounting the unit in a 19-inch rack:
  - RM-35 for IPmux-1 (ordering option)
  - RM-34 for IPmux-1E (supplied with the unit).

2.3 Installation and Setup

Setting Internal Jumpers

IPmux-1

IPmux-1 internal jumpers and switches do not need to be configured by the user. Therefore, removing the product cover is not required.

IPmux-1E

The IPmux-1E FXS/FXO/E&M version needs NO user internal jumper configuration.

The IPmux-1E ISDN version contains jumpers that must be set for phantom feed (see *Figure 2-1*). Open the case and verify the positions of internal jumpers before proceeding to the IPmux-1E installation, which is explained below.

➤ **To open the IPmux-1E case:**

1. Disconnect all the cables connected to IPmux-1E.
2. Release all cover screws at the top and side panels.
3. Remove the IPmux-1E top cover by pulling it back.

➤ **To set the IPmux-1E ISDN-S module jumpers:**

If necessary, change the settings in accordance with the specific requirements of your application:

- ENA – enable phantom feed
- DIS – disable phantom feed.

The phantom feed ENA/DIS setting influences the IPmux-1E ISDN BRI operation mode. When phantom feed is disabled, the S-interface can be configured (through software) to the TE or NT mode. When phantom feed is enabled, only the NT mode is possible.

Warning

Only qualified and authorized service personnel should have access to the inside of the unit.

Disconnect the unit from the power line and from all the cables before removing the cover.

Line voltages are present inside IPmux-1/ 1E when it is connected to power. Moreover, under certain external fault conditions, dangerous voltages may appear on the lines connected to IPmux-1/1E.

Any adjustment, maintenance, and repair of the opened device under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled technician who is aware of the hazards involved. Capacitors inside the device may still be charged even after it has been disconnected from its source of power.

Caution The IPmux-1/1E contains components sensitive to electrostatic discharge (ESD). To prevent ESD damage, avoid touching the internal components, and before moving jumpers, touch the IPmux-1/1E rear panel.

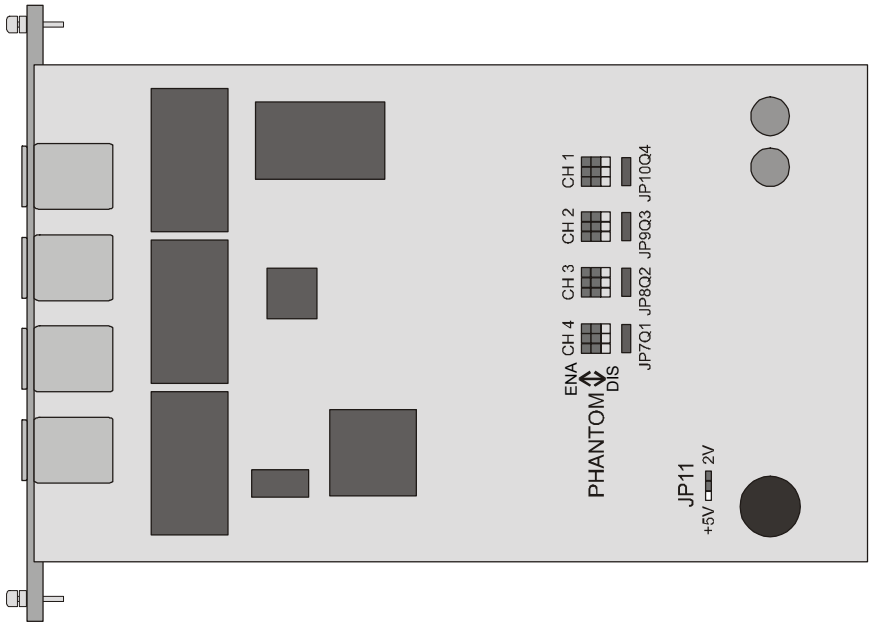

Figure 2-1. IPmux-1E ISDN-S Jumpers

➤ **To reinstall the top cover:**

1. Position the IPmux-1/1E case on a flat, clean surface.
2. Slide the cover into the slots from the rear panel, and set the cover in place.
3. Fasten the cover with the 14 screws.

Connecting Interfaces and Cables

Figure 2-2 through *Figure 2-5* illustrate the front and rear panel options available for IPmux-1.

Figure 2-6 through *Figure 2-8* illustrate the rear and front panel options available for IPmux-1E.

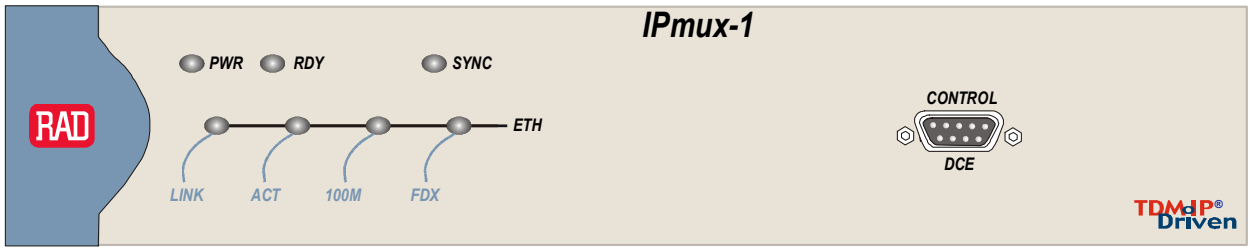

Figure 2-2. IPmux-1 Front Panel

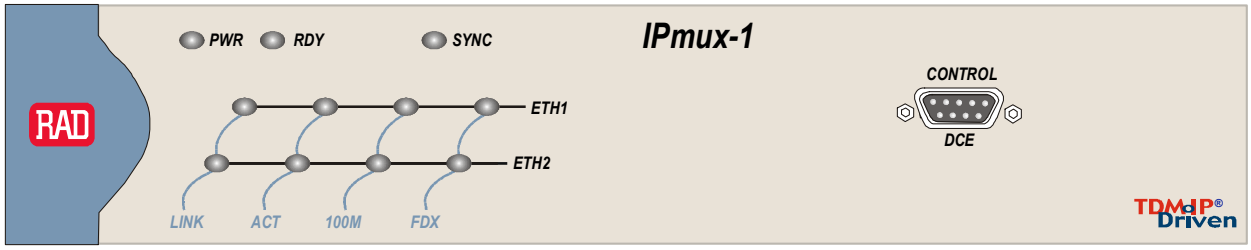

Figure 2-3. IPmux-1 Front Panel for Two Ethernet Ports

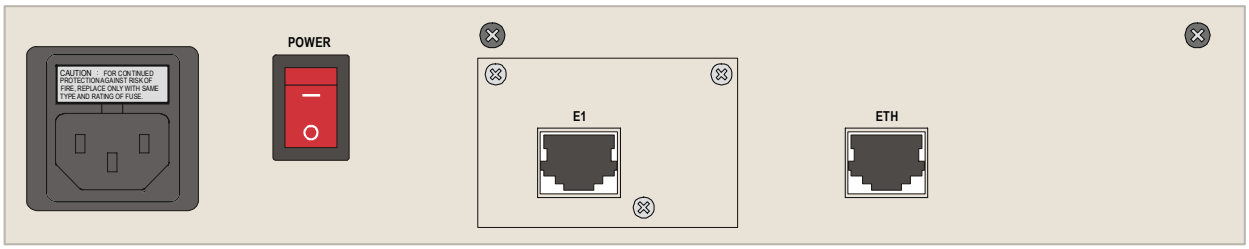

Figure 2-4. IPmux-1 Rear Panel

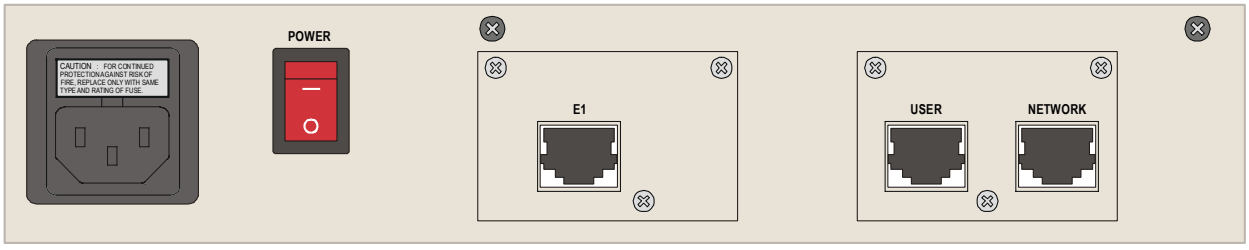

Figure 2-5. IPmux-1 Rear Panel for Two Ethernet Ports

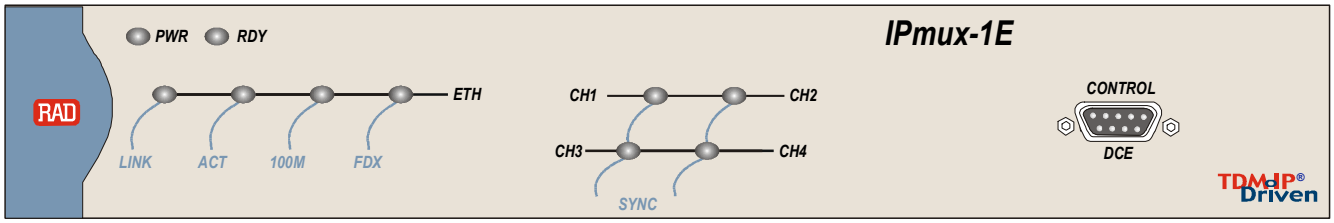

Figure 2-6. IPmux-1E Front Panel

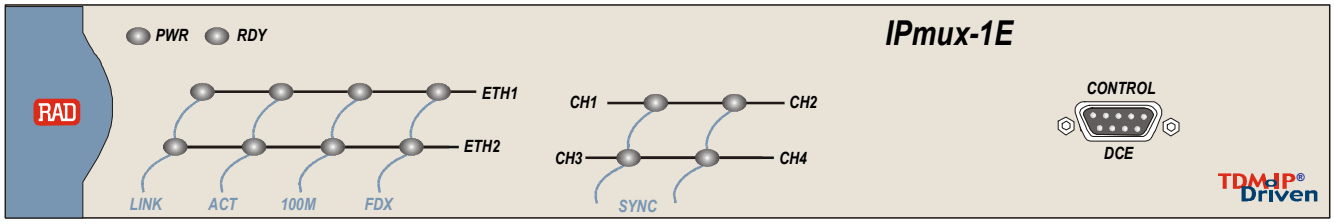

Figure 2-7. IPmux-1E Front Panel for Two Ethernet Ports

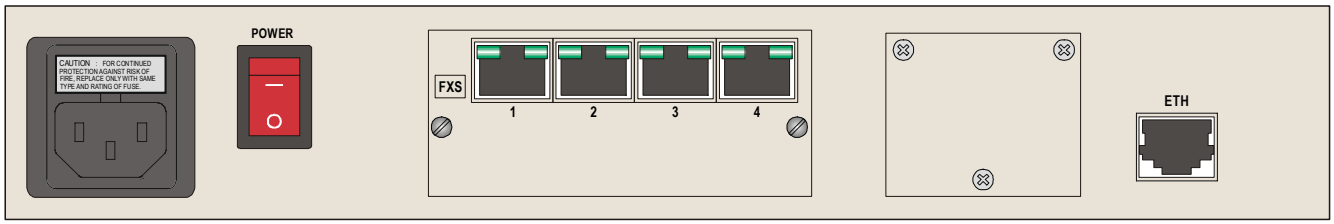

Figure 2-8. IPmux-1E Rear Panel (FXS Option)

Location of Connectors

Interface connections are made from the IPmux-1/1E back panel, as shown in *Figure 2-2*.

- *Table 2-1* lists the E1/T1 port pin assignment
- *Table 2-2* lists the Ethernet port pin assignment
- *Table 2-3* lists the control port pin assignment
- *Table 2-4* lists the ISDN-S connector pin assignment.
- *Table 2-5* lists the FXS/FXO connector pin assignment
- *Table 2-6* lists the E&M connector pin assignment
- *Table 2-7* lists the external clock port pin assignment.

Table 2-1. E1/T1 Port Connectors Pin Assignment

Pin	Designation	Direction	Function
1	RD (R)	Input	Receive data (ring)
2	RD (T)	Input	Receive data (tip)
3, 6	–	–	FGND
4	TD (R)	Output	Transmit data (ring)
5	TD (T)	Output	Transmit data (tip)
7, 8	–	N/A	Not connected

Table 2-2. Ethernet Port Pin Assignment

Pin	Function
1	Tx+
2	Tx–
3	Rx+
4	–
5	–
6	Rx–
7	–
8	–

Table 2-3. Control Port Pin Assignment

Pin	Function
1	–
2	Rx
3	Tx
4	–
5	GND
6	–
7	–
8	–
9	–

Table 2-4. ISDN-S-Interface Pin Assignments

Pin	Function
3	Tx+
4	Rx+
5	Rx–
6	Tx–

Table 2-5. FXS/FXO Interface Pin Assignment

Pin	Designation	Direction	Function
1, 2			Not connected
3	RING	IN/OUT	Two-wire input/output
4	TIP	IN/OUT	Two-wire input/output
5, 6			Not connected

Table 2-6. E&M Interface Pin Assignment

Pin	Designation	Function
1	SB	Signaling battery
2	M	M lead input
3	R1-0UT	4-wire voice output 2-wire voice input/output
4	R-IN	4-wire voice input
5	T-IN	4-wire voice input
6	T1-OUT	4-wire voice output 2-wire voice input/output
7	SC	Function depends on signalling mode: • RS-464 Type I, III: Direct connection to signal ground • RS-464 Type V, SSDCS: Connection to signal ground through 1.1 kΩ resistor • RS-464 Type II: SG lead
8	E	E lead output

Table 2-7. External Clock Port Pin Assignment

Pin	Signal Name	Function
1	RRING	Rx
2	RTIP	Rx
3	GND	Usually not connected
4	TRING	Tx
5	TTIP	Tx
6	GND	Usually not connected
7	–	Not connected
8	–	Not connected

Connecting the Power

To connect power to IPmux-1/1E, refer to the appropriate section below, depending on your version of the unit (AC or DC).

Grounding

Interrupting the protective grounding conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

Warning

Before switching ON this instrument and before connecting any other cable, the protective earth terminals of this instrument must be connected to the protective ground conductor of the power cord.

Fuses

Make sure that only fuses with the required rated current and specified type, as marked on the IPmux-1/1E rear panel, are used for replacement: 1.6A T 250V. Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and secured to prevent any operation.

Connecting the AC Power

AC power is supplied to IPmux-1/1E through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong plug. The cable is supplied with the unit.

➤ **To connect AC power:**

1. Verify that the AC outlet is grounded properly. Ensure that the supply voltage is in the range 100 VAC to 240 VAC.
2. Check that the POWER switch on the rear panel is set to OFF.
3. Connect the power cable to the rear panel connector first and then to the AC mains outlet.

Connecting the DC Power

➤ **To connect DC power:**

- Refer to the DC power supply connection supplement.

Warning

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply, in order to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e., an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source, and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A.

Before connecting the DC input plug, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment, and switch it to the OFF position. When connecting the other end of the DC cable, first connect the ground wire, then the position pole, and lastly the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

Chapter 3
Operation

This chapter:

- Provides a detailed description of the front panel controls and indicators and their functions
- Explains power-on and power-off procedures
- Provides instructions for using a terminal connected to the IPmux-1/1E control port
- Describes how to navigate menus
- Illustrates the following menus:
  - Main menu
  - Configuration menu
  - Viewing system information
  - Monitoring IPmux-1/1E performance.

For a detailed explanation of parameters on the menus, see *Appendix E*.

3.1 Front Panel Controls, Connectors, and Indicators

The IPmux-1/1E LEDs (see *Figure 3-1* and *Figure 3-2*) are located on the left side of the front panel. *Table 3-1* and *Table 3-2* list the functions of the IPmux-1 and IPmux-1E system indicators and switches

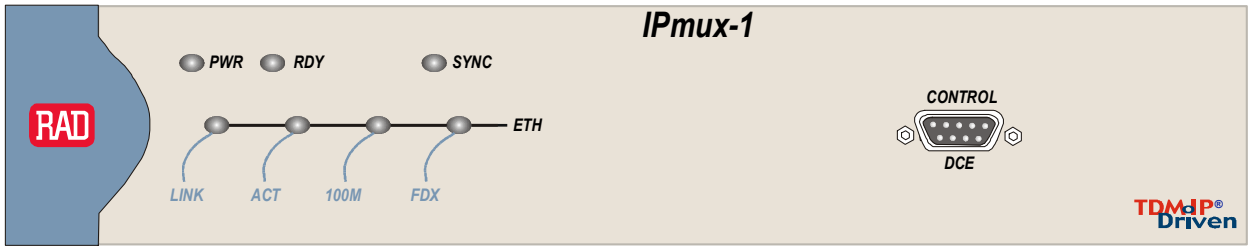

Figure 3-1. IPmux-1 Front Panel

Table 3-1. IPmux-1 LED Indicators

Name	Function
PWR	ON – Unit is powered on
	OFF – Unit is powered off
RDY	ON – Unit is operating properly
	OFF – Self-test is in progress
	Blinking – Malfunction is detected
SYNC	ON – TDM port is synchronized (no alarm)
	OFF (unframed) – Signal loss or AIS detected
	OFF (framed) – Signal loss, loss of frame or AIS detected
	Blinking – RDI is detected (remote alarm)
ETH LINK	ON – Link is OK
	OFF – Link is not active
ETH ACT	ON – Frame is being transferred on link
	OFF – No activity is detected on the link
ETH 100M	ON – 100 Mbps
	OFF – 10 Mbps
ETH FDX	On: Full-duplex
	Off: Half-duplex

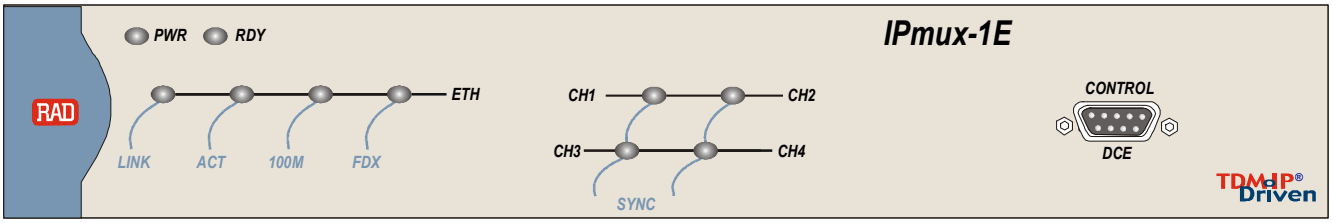

Figure 3-2. IPmux-1E Front Panel

Table 3-2. IPmux-1E (BRI/FXS/FXO/E&M) LED Indicators

Name	Function	
PWR	ON – Unit is powered on	
	OFF – Unit is powered off	
RDY	ON – Unit is operating properly	
	OFF – Self-test is in progress	
	Blinking – Malfunction is detected	
SYNC CH1–CH4	ISDN	ON – ISDN port is synchronized
		OFF – LOF is detected
	FXS/FXO/E&M	ON – OFF hook
		OFF – ON hook
		Blinking – Ringing
ETH LINK	ON – Link is OK	
	OFF – Link is not active	
ETH ACT	ON – Frame is being transferred on link	
	OFF – No activity is detected on the link	
ETH 100M	ON – 100 Mbps	
	OFF – 10 Mbps	
ETH FDX	On: Full-duplex	
	Off: Half-duplex	

3.2 Operating Instructions

Turning IPmux-1/1E On

Without Control Terminal

The IPmux-1/1E power switch is located on the rear panel.

➤ **To power up IPmux-1/1E without a control terminal:**

1. Set the power supply switch, located on the rear panel, to ON.
2. Check the unit LED indicators, located on the left side of the front panel, and the module indicators for proper operation (see *Figure 3-1, Figure 3-2, Table 3-1* and *Table 3-2)*.

With Control Terminal

➤ **To power up IPmux-1/1E with a control terminal:**

1. Make sure all IPmux-1/1E cables and connectors are properly connected.
2. Connect IPmux-1/1E to a PC equipped with an ASCII terminal-emulation application.
3. Turn on the control-terminal PC and set its default port parameters to 19,200 baud, 8 bits/character, 1 stop bit, no parity. Set the terminal emulator to ANSI VT100 emulation (for optimal view of system menus).
4. Set the POWER switch, located on the rear panel, to ON.
5. When the initialization and self-test are over, a menu appears displaying initialization and self-test results. If the self-test is successful, the RDY LED (*Figure 3-1* and *Figure 3-2*) on the left side of the front panel lights up. If problems are encountered, refer to *Chapter 4* for instructions.
6. Press **<Esc>** to open the configuration software.
7. Enter your User Name according to your assigned system privileges (either Supervisor (**su**) or **User** and then your Password when prompted (the factory-set password is **xxxxxxxxxx**).

   The Main menu is displayed (*Figure 3-9*).

Note *If the password is invalid in three consecutive attempts, the system becomes inaccessible for 15 minutes.*

Login

User Name and Password

➤ **To enter as a superuser:**

1. Enter **su** for User Name.
2. Enter **xxxxxxxxxx** for Password.

This allows you to configure all the parameters of IPmux-1/1E, and to change the *su* and *user* passwords.

➤ **To view the unit's configuration:**

1. Enter **user** for User Name.
2. Enter **xxxxxxxxxx** for Password.

This does not allow you to make configuration changes.

➤ **To set all passwords to the default value (xxxxxxxxxx):**

- Delete the unit's configuration through the Configuration screens.

Note *Deleting the unit's configuration using <**Ctrl+A**> and choosing **4** in the Boot menu does not set the password to the default value.*

Turning IPmux-1/1E Off

➤ **To power off the unit:**

- Set the rear panel POWER switch to OFF.

3.3 Getting Started

After installation, there are no special operating procedures for IPmux-1/1E. Once it is powered up, the unit operates automatically.

If required, IPmux-1/1E can be reconfigured. Both the IPmux-1/1E configuration and monitoring operations are performed locally from an ASCII terminal connected to the control port. Detailed configuration procedures are given in *Overview of Menu Operations* and *Appendix E*.

The following functions are supported (see menu trees in *Figure 3-3*, *Figure 3-4*, *Figure 3-5*, *Figure 3-6*, *Figure 3-7*, and *Figure 3-8*):

- Viewing system information
- Modifying configuration and mode of operation, including setting system default values
- Viewing statistics and status.

3.4 Overview of Menu Operations

Navigating

Navigate the IPmux-1/1E terminal menus to set and view configuration parameters:

- *Figure 3-3* maps the IPmux-1 terminal menus except for the Connection Configuration menu.
- *Figure 3-4* maps the IPmux-1E ISDN-S terminal menus except for the Connection Configuration menu.
- *Figure 3-5* maps the IPmux-1E FXS/FXO/E&M terminal menus except for the Connection Configuration menu.
- *Figure 3-6* maps the IPmux-1E Connection Configuration menu for Static Mode.
- *Figure 3-7* maps the IPmux-1E Connection Configuration menu for Dynamic CAS Mode.
- *Figure 3-8* maps the IPmux-1E Connection Configuration menu for CESoIP Mode.

Use these menu trees as a reference aid while performing configuration and control functions. *Appendix E* illustrates menus, explains parameters, and lists default values. Refer to *Appendix E* to find specific parameters.

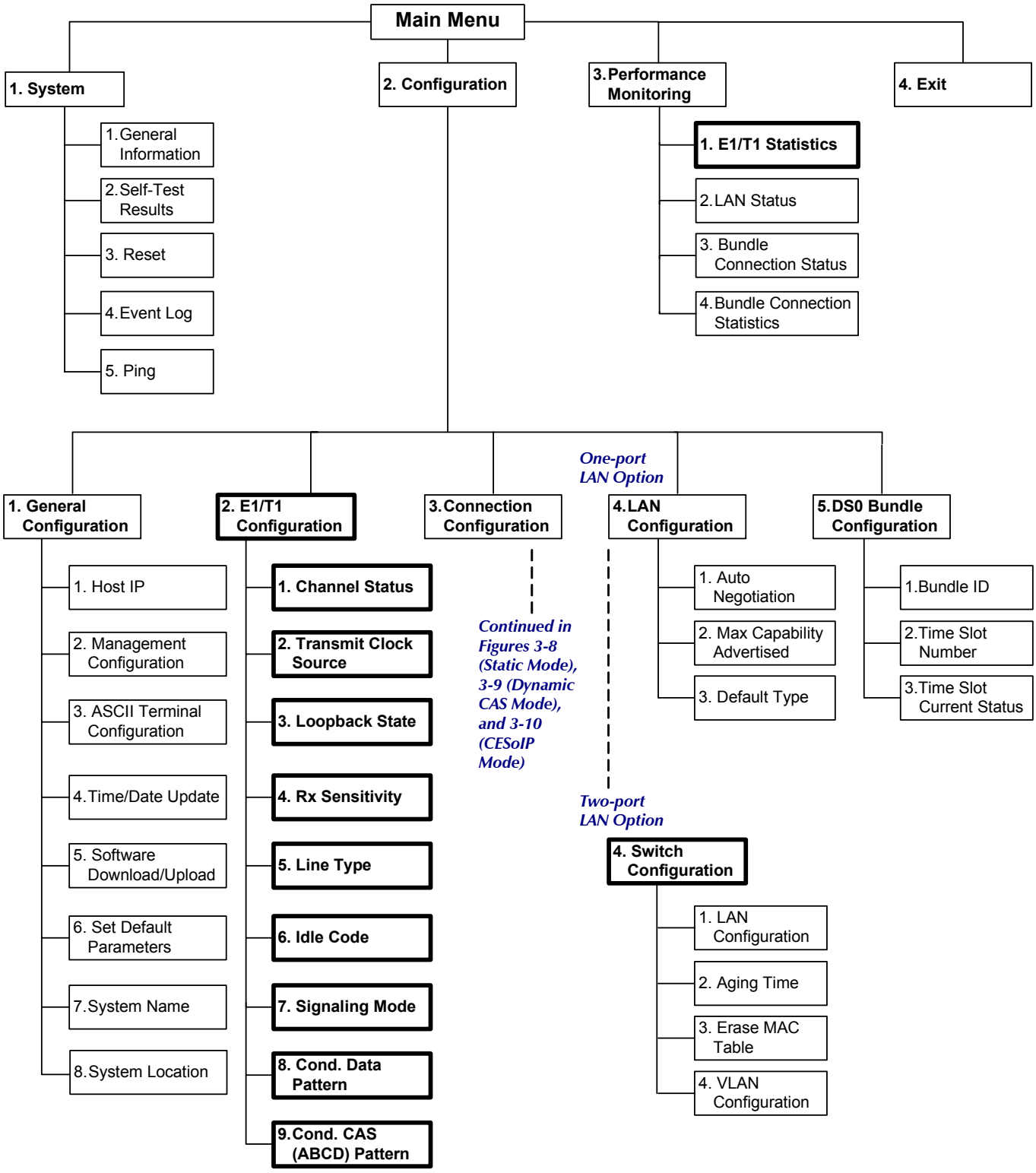

Figure 3-3. IPmux-1 (E1/T1) Terminal Menu Tree

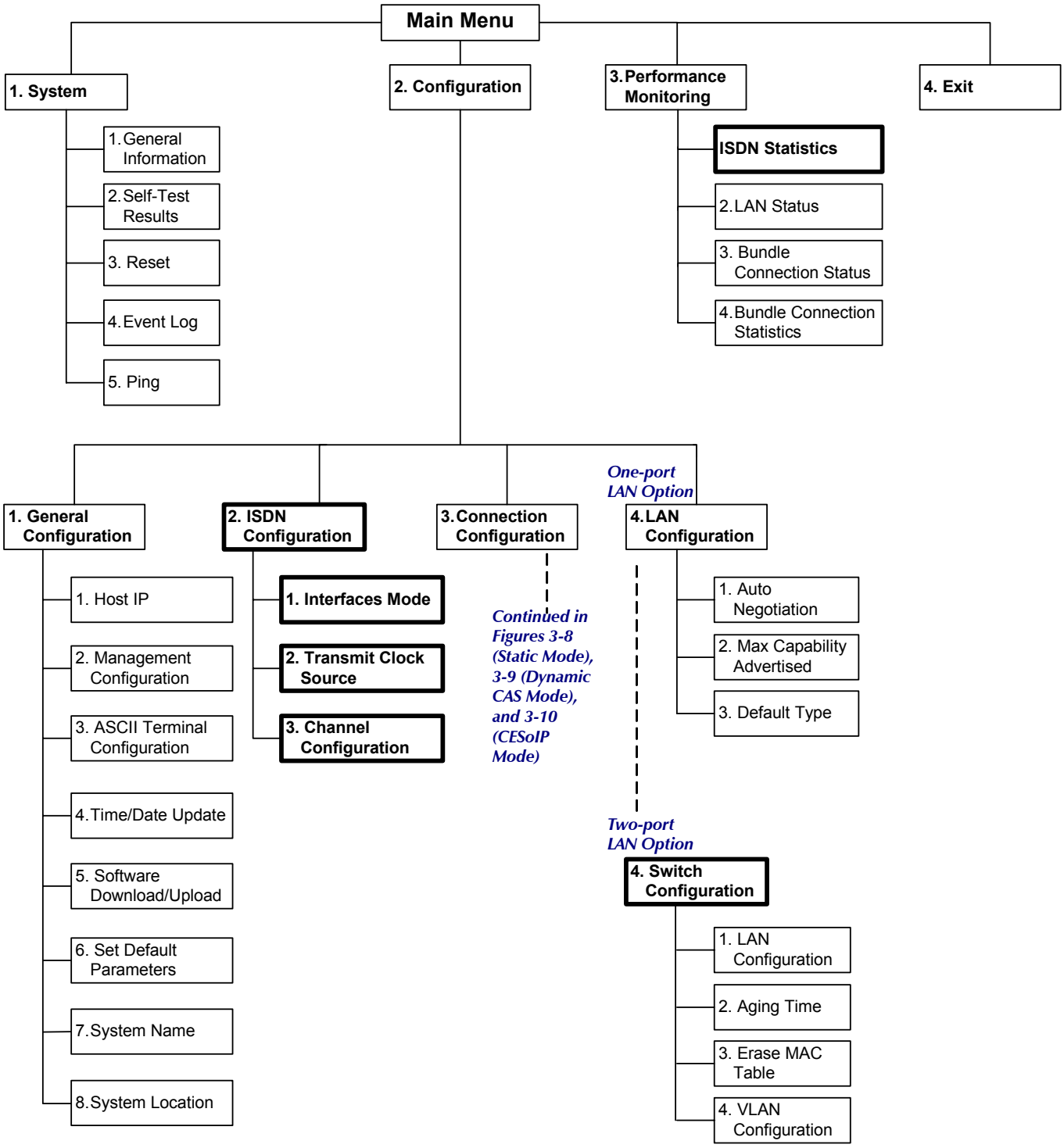

Figure 3-4. IPmux-1E ISDN-S Terminal Menu Tree

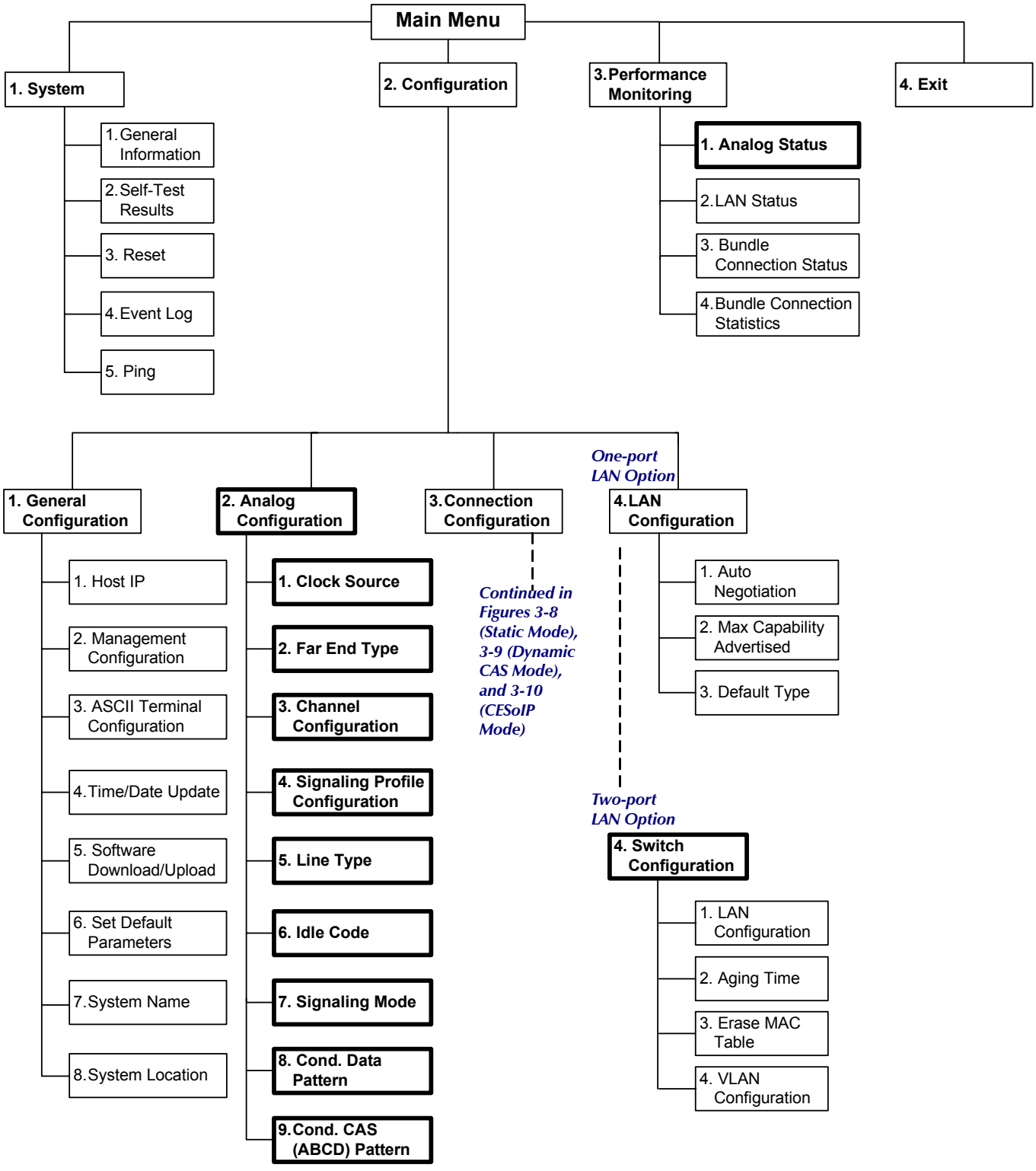

Figure 3-5. IPmux-1E FXS/FXO/E&M Terminal Menu Tree

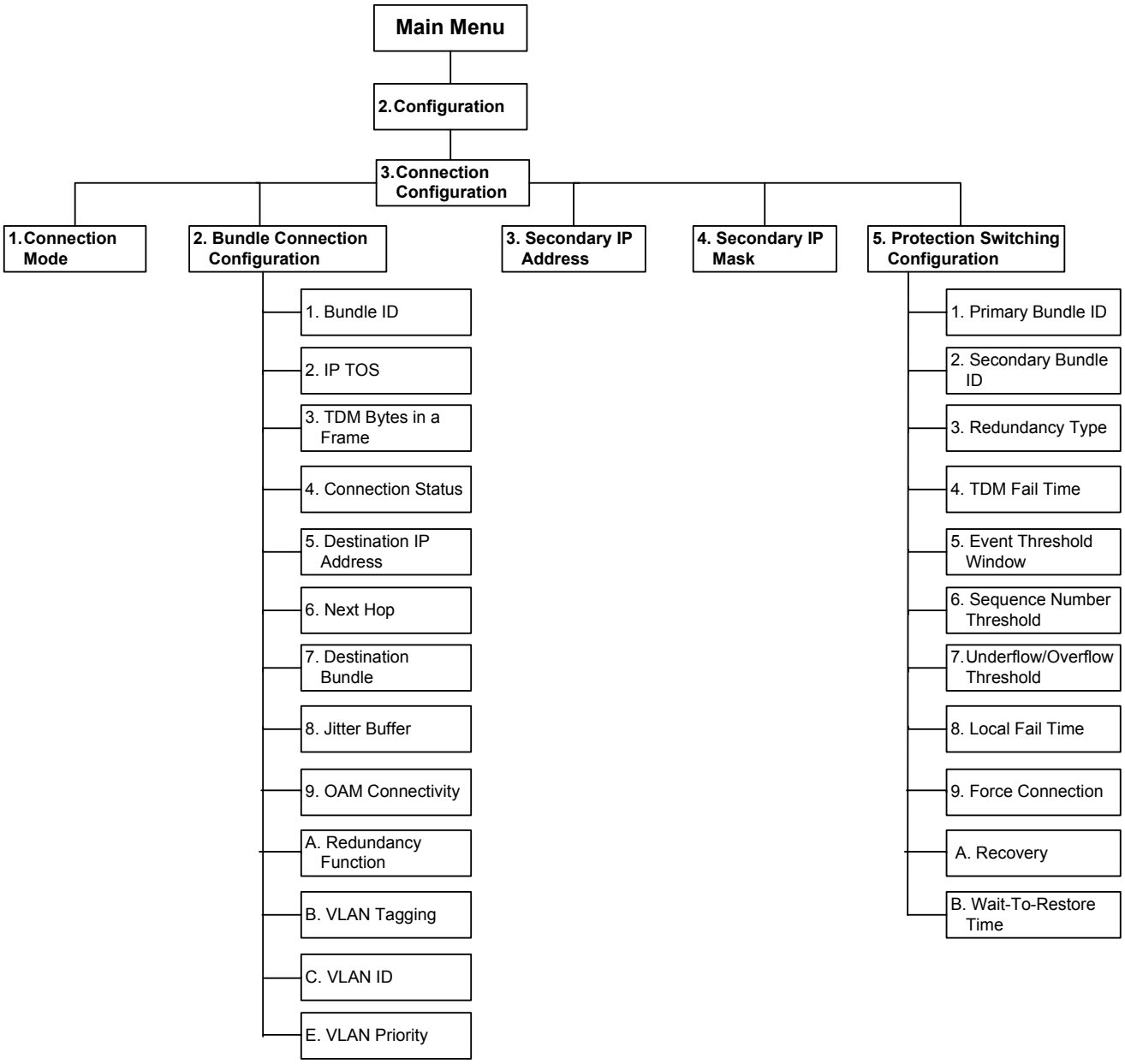

Figure 3-6. IPmux-1/1E Connection Configuration Menu Tree for Static Mode

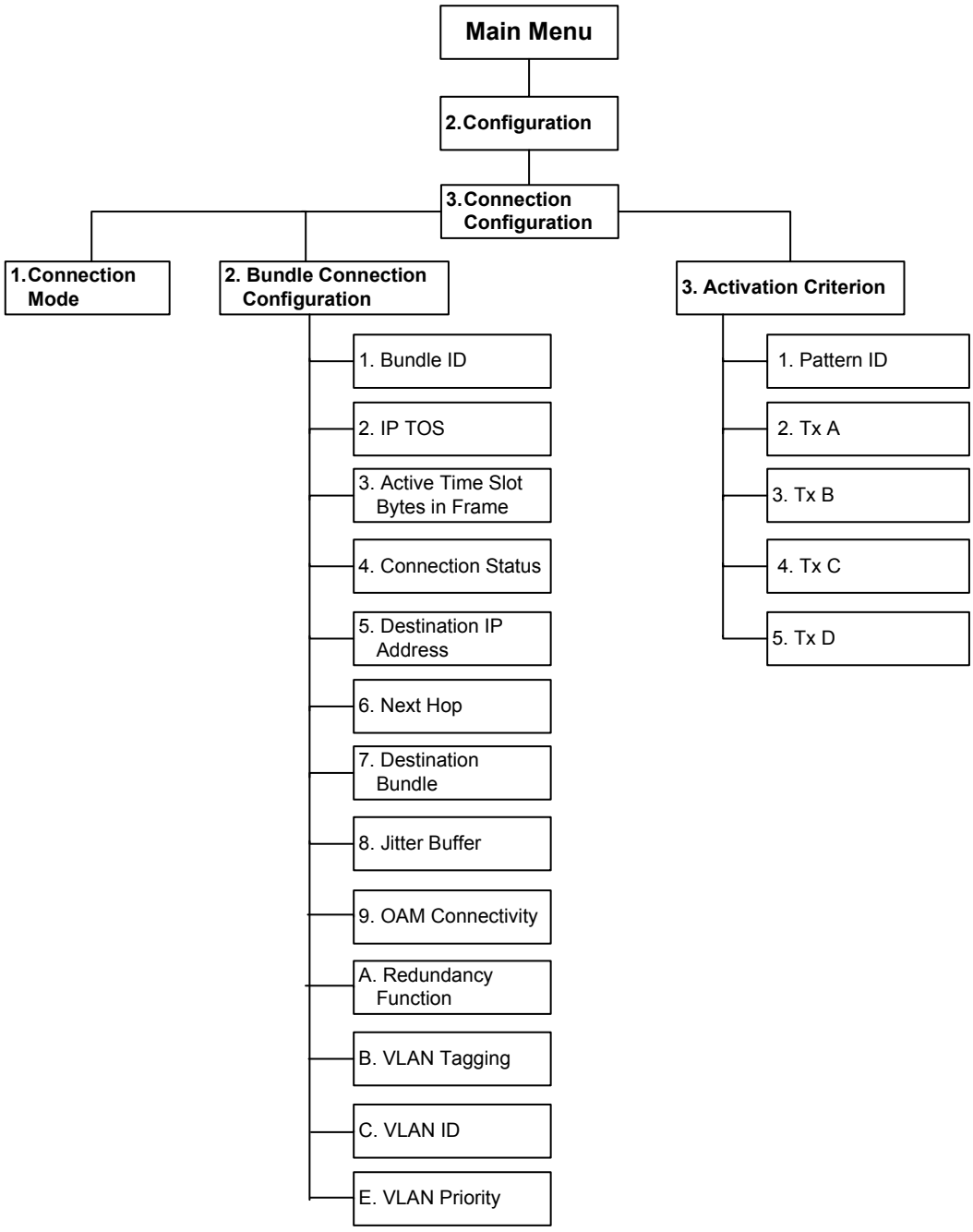

Figure 3-7. IPmux-1E Connection Configuration Menu Tree for Dynamic CAS Mode

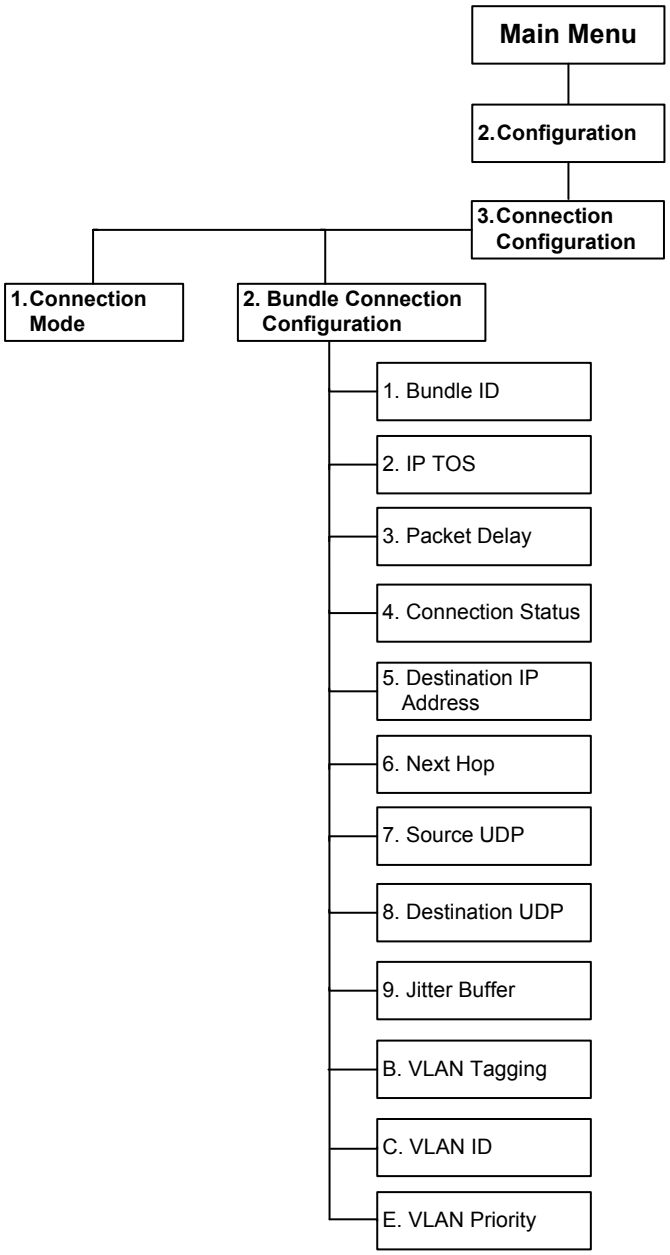

Figure 3-8. IPmux-1E Connection Configuration Menu Tree for CESoIP Mode

Main Menu

Figure 3-9 shows the IPmux-1/1E Main Menu. Access all system configuration and control functions via this menu.

The Main menu options are described in *Table 3-3*.

At any point and from any screen, you can press **<Esc>** repeatedly, backing up until you reach the main menu.

You exit the program only from this menu. In order to prevent unauthorized access, it is recommended that when you finish a session, you return to the Main Menu and type **4** to exit the program. A password is then required for reentry.

Table 3-3. IPmux-1/1E Main Menu Options

Option	Description
1. System	View and modify system parameters
2. Configuration	Define system configuration
3. Performance Monitoring	Monitor system performance
4. Exit	Exit the control software

```
                          MAIN MENU

1.System                                  >
2.Configuration                           >
3.Performance Monitoring                  >
4.Exit


Select item from the menu:                _
Use keys <1> to <4>
```

Figure 3-9. IPmux-1/1E Main Menu

System Menu

➤ **To access the System menu:**

- Type **1** (System) in the **Main Menu**.

From the System menu (see *Figure 3-10*) you can view and configure the options described in *Table 3-4*. These options are explained in full detail in *Appendix E*.

Table 3-4. IPmux-1/1E System Menu Options

Option	Description
1. General Information	View IPmux-1/1E general information
2. Self-Test Results	Review self-test results obtained during system power-up.
3. Reset	Reset IPmux-1/1E
4. Event Log	View a list of IPmux-1/1E events
5. Ping	Ping other network devices

```
                              SYSTEM

1. General Information

2. Self-Test Results

3. Reset

4. Event Log  >

5. Ping


ESC.  Exit


Select item from the menu.
```

Figure 3-10. IPmux-1/1E System Menu

Setting IPmux-1/1E Configuration Options

➤ **To access the Configuration menu:**

- Type **2** (Configuration) in the **Main Menu**.

  The IPmux-1E E1/T1 Configuration menu is shown in *Figure 3-3* and *Figure 3-11*.

  The IPmux-1E ISDN-S Configuration menu is shown in *Figure 3-4* and *Figure 3-12*.

  The IPmux-1E FXS/FXO/E&M Configuration menu is shown in *Figure 3-5*and *Figure 3-13*.

Table 3-5 describes the configuration options.

```
                          CONFIGURATION

1. General Configuration

2. E1/T1 Configuration

3. Connection Configuration

4. Switch Configuration

5. DS0 Bundle Configuration

ESC. Exit

Select item from the menu:                    _
```

Figure 3-11. IPmux-1/1E Configuration Menu

```
                    CONFIGURATION
1. General Configuration
2. ISDN Configuration
3. Connection Configuration
4. LAN Configuration
ESC. Exit

Select item from the menu:                    _
```

Figure 3-12. IPmux-1E ISDN-S Configuration Menu

```
                    CONFIGURATION
1. General Configuration
2. Analog Configuration
3. Connection Configuration
4. LAN Configuration
ESC. Exit

Select item from the menu:                    _
```

Figure 3-13. IPmux-1E FXS/FXO/E&M Configuration Menu

From the Configuration menu you can view and configure the following options:

Table 3-5. Configuration Options

Option	Description
1. General Configuration	Configure Host IP, Default Gateway, ASCII Terminal Configuration, Time/Date update, and Default parameters, and download software updates
2. E1/T1/ISDN/FXS/FXO/E&M Configuration	Configure E1/T1, ISDN, FXS, FXO, or E&M physical layer
3. Connection Configuration	Configure IP ToS, TDM bytes/frame, VLAN tagging, and Redundancy Function
4. LAN Configuration	Configure Ethernet physical layer
5. DS0 Bundle Configuration	Configure TS assignment to the bundle (***Note**: only for IPmux-1*)

Specific parameters are explained in *Appendix E*.

Performance Monitoring

➤ **To view performance statistics:**

- Type **3** (Performance Monitoring) in the **Main** menu.

Typical menus are shown in *Figure 3-14*, *Figure 3-15*, and *Figure 3-16*.

Table 3-6 describes the Performance Monitoring options.

Further details for specific parameters are explained in *Appendix E*.

```
                    PERFORMANCE MONITORING


1. E1/T1 Statistics
2. LAN Status
3. Bundle Connection Status
4. Bundle Connection Statistics

ESC. Exit
Select item from the menu.
```

Figure 3-14. Performance Monitoring Menu for IPmux-1

```
                    PERFORMANCE MONITORING


1. ISDN Statistics
2. LAN Status
3. Bundle Connection Status
4. Bundle Connection Statistics

ESC. Exit
Select item from the menu.
```

Figure 3-15. Performance Monitoring Menu for IPmux-1E ISDN-S

```
                    PERFORMANCE MONITORING


1. Analog Status
2. LAN Status
3. Bundle Connection Status
4. Bundle Connection Statistics


ESC. Exit
Select item from the menu.
```

Figure 3-16. Performance Monitoring Menu for IPmux-1E FXS/FXO/E&M

Table 3-6. Performance Monitoring Menu Options

Option	Description
1. E1/T1/ ISDN/ Analog Statistics	Statistics for E1/T1, ISDN, or FXS/FXO/E&M – updated at 15 minute intervals
2. LAN Status	Status of LAN port(s)
3. Bundle Connection Status	Status of defined connections
4. Bundle Connection Statistics	Statistics for defined connections – updated at 15 minute intervals

Chapter 4

Troubleshooting and Diagnostics

This chapter describes how to:

- Detect errors
- Troubleshoot problems
- Perform diagnostic tests.

4.1 Error Detection

Using Front Panel LEDs

LED indicators on the front panel IPmux-1/1E indicate the operating status of the module. The LED indicators are described in *Chapter 3* of this manual.

Working with the Alarm Buffer

IPmux-1/1E maintains an Event Log File. All events are time-stamped. The user can view the contents of the Event Log File via an ASCII terminal or a Telnet session. The user can also clear the contents of the log file.

Table 4-1 presents the event types that appear on the Event Log File alphabetically, as well as the actions required to correct the event (alarm) indication.

To correct the reported problem, perform corrective actions in the given order until the problem is corrected. If the problem cannot be fixed by carrying out the listed actions, IPmux-1/1E **MUST** be checked by the **authorized** technical support personnel.

Table 4-1. Event Types

Event	Description	Corrective Action
COLD START	IPmux-1/1E has been powered up	None
CON LOCAL FAIL	Ethernet frames are not received by the local IPmux-1 on the specified connection	Check Eth/IP path
CON REMOTE FAIL	Ethernet frames are not received by the remote IPmux-1 on the specified connection	Check Eth/IP path
CON STANDBY	Redundancy bundle connection is not the active connection (only applies when redundancy is used)	None
CON TDM FAIL	LOS/LOF on the TDM line forced redundancy switching (only applies when redundancy is used)	Check the TDM line
CON SYNC	Bundle connection failure has ended (only applicable when OAM is Enabled)	None
CON UNAVAILABLE	Remote IPmux is not available (only applicable when OAM is Enabled)	Check the connection of the remote IPmux
CON VALIDATION FAIL	Connection is invalid (only applicable when OAM is Enabled)	Check the bundle parameters
FATAL ERROR	IPmux-1/1E has encountered an internal fatal error	The IPmux-1/1E requires servicing
IP ADDRESS IS ASSIGNED BY SERVER	Host IP has been learned by the DHCP protocol	None
IP ADDRESS IS RELEASED	Host IP has been relesased by the DHCP protocol	Check the connection with the DHCP server
JIT BUF OFLOWS END BUNDLE 1	*Jitter Buffer Overflows END	Refer to Bundle Configuration Statistics in *Appendix E*
JIT BUF OFLOWS START BUNDLE 1	*Jitter Buffer Overflows START	Refer to Bundle Configuration Statistics in *Appendix E*
JIT BUF UFLOWS END BUNDLE 1	*Jitter Buffer Underflows END	Refer to Bundle Configuration Statistics in *Appendix E*
JIT BUF UFLOWS START BUNDLE 1	*Jitter Buffer Underflows START	Refer to Bundle Configuration Statistics in *Appendix E*
LINE AIS END	Line AIS state detected has ended	None
LINE AIS START	IPmux-1 has AIS (alarm indicator signal) state on its E1/T1 port	Check for a fault at the PDH network, on the receive direction
LINE FEBE END	LINE FEBE state detected has ended	None

Table 4-1. Event Types (Cont.)

Event	Description	Corrective Action
LINE FEBE START	IPmux-1 has LINE FEBE state on its E1/T1 port	Check for errors in the E1/T1 connection on the transmit direction
LINE RAI END	LINE RAI state detected has ended	None
LINE RAI START	IPmux-1 has LINE RAI (remote alarm indication) state on its E1/T1 port	Check for a fault at the E1/T1 connectivity on the transmit direction
LOGIN ON LOCAL CONSOLE	The unit was accessed via local terminal	None
LOS END	LOS state detected has ended	None
LOS START	IPmux-1 has a LOS (loss of signal) state on its E1/T1 port	Check the port cable connection Check input signal
PS ACTIVE	IPmux-1/1E power supply unit is powered on	None
SN ERRORS END BUNDLE 1	*Sequence Number ERRORS END	Refer to Bundle Configuration Statistics in *Appendix E*
SN ERRORS START BUNDLE 1	*Sequence Number ERRORS START	Refer to Bundle Configuration Statistics in *Appendix E*
SYSTEM USER RESET	The user initiated software reset via the system menu	None

* You can configure whether an item will be displayed for each event or every 1 sec / 1 min. For further information see *Logfile Events* in Appendix E.

4.2 Troubleshooting

Table 4-2 presents the event types as they appear on the Event Log File and lists the actions required to correct the event (alarm) indication. For further information, see *Chapter 3*.

Table 4-2. IPmux-1 Troubleshooting Chart

Fault	Probable Cause	Remedial Action
E1/T1 equipment connected to IPmux-1 is not synchronized with IPmux-1/1E.	Configuration problems Physical layer problems	1. Check cables and physical connectivity. 2. Check IPmux-1 E1/T1 configuration and, if necessary, other IPmux-1 parameters. 3. Check E1/T1 physical connection (use loopbacks).
• Slips and errors in E1/T1/ISDN/FXS/FXO/E&M equipment	• Ethernet port in switch and IPmux-1 are not in the same rate or duplex mode • Ethernet port is set to work in half duplex mode (may cause extreme PDV because of collisions and backoffs) • Timing configuration is not properly set (periodic buffer under/overflows shown on IP channel status menu) • Deactivation employed by NT when IPmux is TE and in loopback timing mode • Network PDV or lost frames	1. Check E1/T1 physical connection (use loopbacks). 2. Check timing settings according to explanation in this manual. 3. Check switch and IPmux-1 port configuration (negotiation, rate, duplex mode). 4. Check PDV introduced by the network, and, if necessary, increase PDVT jitter buffer setting. 5. Check NT deactivation (ISDN BRI).
Echo in voice	High delay in voice path	1. Check network delay and try to decrease it. 2. Try to decrease PDVT (jitter) buffer.

4.3 Performance Monitoring and Troubleshooting Statistics

IPmux provides powerful performance monitoring and troubleshooting tools, which consist of the following four levels (screens):

- E1/T1 statistics – Status of the physical E1/T1 parameters (signal, framing, etc.)
- LAN statistics – Ethernet connection status (speed, duplex mode, bytes transmitted & received, etc.)
- Bundle connection statistics – TDMoIP Bundle/s connection status on the Ethernet/IP network level.
- Bundle status.

There are described below. For additional information, refer to *LAN Configuration (No User Port)* and *Ethernet Configuration/Status (User Port)* in Appendix E.

E1/T1 Statistics

E1/T1 statistics refer to the physical status of the E1/T1 traffic reaching the IPmux from the adjacent E1/T1 device.

The E1 statistics parameters comply with the G.703, G.704, G.804, G706, G732, and G.823 standards.

The T1 statistics parameters comply with the ANSI T.403, AT&T R62411, G.703, G.704 and G.804 standards.

➤ **To view the E1/T1 connection statistics:**

- Select: **Main Menu > Performance Monitoring > E1/T1 Statistics.**

```
                                E1 Statistics
E1 over UTP
LOS:                        0
LOF (Red)                   0

LCV:                        0

RAI (Yellow)                0
AIS:                        0
FEBE:                       0

BES:                        0
SS:                         0
SES:                        0
UAS:                        0

LOMF:                       0

Time Since:           700   sec   ------------------Valid Intervals      1---
1. Interval             0

ESC> Exit             N. Next Inv
```

Figure 4-1. E1 Statistics

Note *E1/T1 statistics are monitored and saved under consecutive Intervals. Each Interval is 15 minutes long. There are 96 intervals, which represent the last 24 hours. Whenever a new Interval is started, the counters are reset to zero. The old interval shows the total of alarms that occurred during its 15-minute period.*
The current active Interval is always marked as Interval 0 (you will see that the ***Time Since*** *counter is running). The previous Interval is marked as 1 and so on. The E1/T1 statistic counters cannot be reset manually. The user can browse the stored Intervals by pressing N for the Next Interval or P for the Previous Interval.*

The physical E1/T1 alarms are:

- LOS
- LOF (RED)
- LCV
- RAI (Yellow)
- AIS
- FEBE

- BES
- DM
- ES
- SES
- UAS
- LOMF

They are described in *Table 4-3*.

Table 4-3. E1/T1 Alarms

Alarm	Description
LOS	A Loss of Signal indicates that there is either no signal arriving from the adjacent E1/T1 device or no valid E1 voltage mask or no voltage alteration between positive and negative amplitudes. For E1 links, the LOS counter will increase by one for each second during which a consecutive 255 pulses have no pulse of negative or positive polarity. For T1 links, the LOS counter will increase by one for each second during which a consecutive 192 pulses have no pulse of negative or positive polarity. A LOS alarm can also be noticeable when the front panel Sync LED is off (Green indicates Synch is on). Recommendations: Check the physical layer (connectors, cables, etc.)
LOF (Red)	A Loss of Frame indicates that the IPmux lost E1/T1 synch opposite its adjacent E1/T1 device. In more detail, this is a period of 2.5 seconds for T1 or 100 msec for E1, during which an OOF (Out Of Frame) error persisted and no AIS errors were detected. For E1 links an OOF defect is declared when three consecutive frame alignment signals have been received with an error. For T1 links, an OOF defect is declared when the receiver detects two or more framing errors within a three msec period for ESF signals and 0.75 msec for D4 signals, or two or more errors out of five or fewer consecutive framing-bits. A LOF alarm can also be noticeable when the front panel Sync LED is off. When the IPmux enters a Red alarm condition, it sends an Yf bit (Yellow alarm or RAI) towards the adjacent E1/T1 device. Recommendations: Check all framing related parameters (CRC-4, CAS enabled/disabled, ESF/D4 (for T1), etc.), and physical connections.

Table 4-3 E1/T1 Alarms (Cont.)

Alarm	Description
LCV	A Line Code Violation indicates an error on the pulse structure, either a **Bipolar Violation (BPV)** or an **Excessive Zeros (EXZ) error event**. BPV is the occurrence of a pulse with the same polarity as the previous pulse. EXZ is the occurrence of a zero string greater than 15 for AMI or 7 for B8ZS. For an E1 link, the LCV counter will increase by one, for each second during which a BPV or EXZ errors have occurred. For T1 links, the LCV counter will increase for each second during which two consecutive BPVs of the same polarity are received. Complies with ITU-TI.431, 0.161, G775 and G.821 standards. Recommendations: Check physical link for bad/loose connection, impedance matching (balanced or unbalanced) and noisy environment.
RAI (Yellow)	A Remote Alarm Indicator is sent by a device when it enters RED state (looses synch). **RAI Alarm** indicates that the adjacent E1/T1 device had lost E1/T1 synch and hence sent an RAI towards the IPmux, which entered a Yellow alarm mode (similarly, IPmux sends RAI towards adjacent E1/T1 when IPmux enters LOF state (Red alarm). In both E1/T1 links the RAI counter increases by one for each second during which an RAI pattern is received from the far end framer. The RAI alarm can also be noticeable when the front panel Sync LED is flashing. Recommendations: Check reason for E1/T1 device to be in LOF (out of synch state) by checking physical link integrity at the Tx direction of the IPmux towards E1/T1 device and framing related parameters.
AIS	An Alarm Indication Signal implies an upstream failure of the adjacent E1/T1 device. AIS will be sent to the opposite direction of which the Yellow alarm is sent. For E1 links, the AIS counter will increase by one for each second during which a string of 512 bits contains fewer than three zero (0) bits. For T1 links, the AIS counter will increase by one for each second during which an unframed “all 1” signal is received for 3 msec. When receiving AIS the Sync front panel LED is off. Recommendations: Check why the E1/T1 device is sending AIS (all ones) stream towards IPmux, for example, Red alarm on a different interface of E1/T1 device (upstream).

Table 4-3 E1/T1 Alarms (Cont.)

Alarm	Description
FEBE	A Far End Block Error is sent to transmitting device notifying that a flawed block has been detected at the receiving device. Exists only for E1 MF-CRC4. The FEBE counter will increase by one for each second during which the FEBE indication is received. Recommendation: Check physical link integrity.
BES	A Bursty Errored Seconds (also known as Errored second type B) is a second during which fewer than 319 and more than one CRC errors occurred with neither AIS nor SEF (Severely Errored Frame) detected. The BES counter will increase by one for each second containing the condition described above. The CRC is calculated for the previous frame in order to prevent processing delay. Complies with AT&T TR-62411 and TR-54016 standards. Not applicable if the line type is set to Unframed. Available only at T1-ESF or E1-CRC4 modes (performance monitoring functionality). Recommendations: Check physical link integrity, G.704 frame format integrity and Sync. (The CRC bits are included in TS0 for E1 multi-frame links and in the frame alignment bits for T1 ESF links).
DM	A Degraded Minute is calculated by collecting all the available seconds, subtracting any SES and sorting the result in 60-second groups. The DM counter will increase by one for each 60-second group in which the cumulative errors during the 60-second interval exceed 1E-6. Available in T1-ESF or E1-CRC4 modes only, (performance monitoring functionality). Recommendations: See BES recommendations.
ES	An Errored Second is a second containing one or more of the following: CRC error SEF (OOF) AIS (T1 only) If SES is active ES runs for 10 seconds and then stops. Recommendations: Check physical link integrity. Follow the recommendation concerning LOF, BEF and AIS.

Table 4-3 E1/T1 Alarms (Cont.)

Alarm	Description
SES	A Severely Errored Second is a second containing one of the following: 320 or more CRC errors events One or more OOF defect One or more AIS events occurred (T1 only) The SES counter will be cleared after reaching 10 and an UAS will then be activated. Recommendations: Check physical link integrity. See also ES alarm recommendation.
UAS	Unavailable Second parameter refers to the number of seconds during which the interface is unavailable. The UAS counter will start increasing after 10 consecutive SES occurrences and will be deactivated as a result of 10 consecutive seconds without SES. After SES clearance the UAS counter will then diminish 10 seconds from the overall count. Recommendations: See above recommendations.
LOMF	A Loss of Multi Frame indicates there is no sync on the multi frame mode, i.e., the receiving device is unable to detect the four ABCD bits pattern on TS16 MSB in frame 0 for two consecutive multi frames. Available only for E1 Multi-Frame mode (CAS). Recommendations: Check physical link integrity, signaling method (CAS enable only), and framing-related parameters.

LAN Statistics

One Ethernet Port

➤ **To view the LAN statistics:**

- Access the ASCII control port terminal via:
  Main Menu > Performance Monitoring > LAN Statistics.

```
                                LAN STATUS
Mac Address                   00-20-D2-17-E4-0E
Mode                          full duplex
Rate (Mbps)                   100
Status                        Connected

Frames received from user
  Correct frames:               312283678
  Correct Octets:             35843622734
  Alignment Err:                        0
  FCS Errors:                           0

Frames transmitted to the user
  Correct frames:               312592435
  Correct Octets:             3613385674
  Singl Collision:                      0
  Multi Collisions:                     0
  Late Collisions:                      0
  Deferred transm:                      0
  Late Collision:                       0
  Carrier Sense:                   684874
ESC. Exit              R. Reset Counters
```

Figure 4-2. LAN Statistics

The LAN Statistics parameters are:

- MAC Address
- Mode
- Rate (Mbps)
- Status
- Frames Received
  - Correct Frames
  - Correct Octets
  - Alignment Error
  - FCS Errors

- Frames transmitted
  - Correct Frames
  - Correct Octets
  - Single Collision
  - Multi-Collision
  - Deferred Transmission
  - Late Collision
  - Carrier Sense.

Table 4-4. LAN Statistics Parameters

Parameter	Description
MAC Address	MAC address of the local port.
Mode	Port mode is set either manually or via the auto-negotiation mode (under LAN configuration screen). *Note: When auto-negotiation protocols do not support each other, this will degrade the connection to a half-duplex mode.* *In order to avoid this, auto-negotiation should be disabled and the ports should be configured/forced manually. Half-duplex degradation will occur also when auto-negotiation is enabled at one port and disabled at the opposite port.*
Rate (Mbps)	Port rate is set either manually or via the auto negotiation mode.
Status	Link status: Connected = Normal operation. Not connected = Ethernet Link loss
Frames Received	
Correct Frames	The number of frames successfully received. When a valid connection is established the number should increase steadily.
Correct Octets	The number of octets successfully received. When a valid connection is established the number should increase steadily.
Alignment Errors	The number of frames received that are not an integral number of octets in length (RFC 1643). All frames should end on an 8-bit boundary, but physical problems on the network could cause the number of bits to deviate from the multiple of eight. Recommendations: Check physical connections, devices and configuration.
FCS Errors	Counts the number of frames received that do not pass the FCS check (RFC 1643). An FCS check is a mathematical way to ensure that all the frame bits are correct without the system having to examine each bit and compare it against the original. Recommendations: Check for physical problem such as hardware problem, or a bad line, or noisy environment.

Table 4-4. LAN Statistics Parameters (Cont.)

Parameter	Description
Frames Transmitted	
Correct Frames	The number of frames successfully transmitted. When a valid connection is established the number should increase steadily.
Correct Octets	The number of octets successfully transmitted. When a valid connection is established the number should increase steadily.
Single Collision	Collisions occur only in Half-duplex mode (RFC 1643). Counts the successfully transmitted frames for which transmission is inhibited by exactly one collision (see Collision above). Recommendations: Use a Full-duplex mode if possible.
Multi Collision	Multi Collisions occur only in Half Duplex mode (RFC 1643). Counts the successfully transmitted frames for which transmission is inhibited by more than one collision (multi-collision). Recommendations: Use a Full-duplex mode if possible.
Deferred Transmission	Occur only in half-duplex mode (RFC 1643). Counts the number of frames for which the first transmission attempt (carrier sense) is delayed because the medium is busy. This is normal behavior when trying to transmit high traffic rate in a half-duplex environment. The higher the traffic rate is, the higher the chances of collisions and deferred transmissions. Recommendations: Use a Full-duplex mode if possible.
Late Collision	Occur only in Half-duplex mode (RFC 1643). In order to allow collision detection to work properly, the period in which collisions are detected is restricted (512 bit-times). For 10BaseT Ethernet (10 Mbps), it is 51.2us (microseconds), and for Fast Ethernet (100Mbps), 5.12us. For Ethernet stations, collisions can be detected up to 51.2 microseconds after the beginning of the transmission, or in other words: up to the 512th bit of the frame. When a station detects a collision after it has sent the 512th bit of its frame, this is counted as a late collision. Recommendations: Possible causes are usually incorrect cabling or a non-compliant number of hubs in the network. Bad Network Interface Cards (NICs) can also cause late collisions.
Carrier Sense	The counter increments when a packet collides because carrier sense is disabled. Recommendations: Check connection between the interface and its Ethernet transceiver.

With User Ethernet Port

➤ **To view the LAN statistics:**

- Access the ASCII control port terminal via:
  Main Menu > Performance Monitoring > LAN Statistics.

```
                              LAN STATUS
Mac Address                  00-20-D2-17-E4-0E
Mode                         full duplex
Rate (Mbps)                  100
Status                       Connected

Frames received
  Total frames:                20460229
  Total Octets:               1923230146
  Oversize Frames:                     0
  Fragments:                           0
  Jabber:                              0
  Dropped Frames:                      0
  CRC Errors:                          0

Frames transmitted
  Correct frames:              20460817
  Correct Octets:             1923285606
  Collision:                           0

Channel: Network

ESC. Exit            R. Reset Counters              N. Next Channel
```

Figure 4-3. LAN Statistics

Note *IPmux-1/1E with user LAN port features three different LAN statistics screens:*

- *Network*
- *User LAN*
- *Internal.*

The Internal screen refers to the internal switch leg connected to the TDMoIP mechanism.

The LAN Statistics parameters are:

- MAC Address
- Mode
- Rate (Mbps)
- Status
- Frames Received
  - Total Frames
  - Total Octets
  - Oversize Frames
  - Fragments
  - Jabber
  - Dropped Frames
  - CRC Errors
- Frames Transmitted
  - Correct Frames
  - Correct Octets
  - Collisions
  - Multi-Collision.

Table 4-5. LAN Statistics Parameters

Parameter	Description
MAC Address	MAC address of the local port.
Mode	Port mode is set either manually or via the auto-negotiation mode (under LAN configuration screen). *Note: When auto-negotiation protocols do not support each other, this will degrade the connection to a half-duplex mode.* *In order to avoid this, auto-negotiation should be disabled and the ports should be configured/forced manually. Half-duplex degradation will occur also when auto-negotiation is enabled at one port and disabled at the opposite port.*
Rate (Mbps)	Port rate is set either manually or via the auto negotiation mode.
Status	Link status: Connected = Normal operation. Not connected = Ethernet Link loss

Table 4-5. LAN Statistics Parameters (Cont.)

Parameter	Description
Frames Received	
Total Frames	The total number of correct frames received. When a valid connection is established the number should increase steadily.
Total Octets	The total number of octets (bytes) received. When a valid connection is established the number should increase steadily.
Oversize Frames	Number of frames exceeding the maximum allowed frame size, but are otherwise valid Ethernet frames (good CRC).
Fragments	The number of frames that are shorter than 64 bytes and have an invalid CRC.
Jabber	The number of frames that are too long and have an invalid CRC. A jabber is transmission by a data station beyond the time interval allowed by the protocol, usually affecting the rest of the network. In an Ethernet network, devices compete for use of the line, attempting to send a signal and then retrying in the event that someone else tried at the same time. A jabber can look like a device that is always sending, effectively bringing the network to a halt. Recommendations Check network interface card or any other transmitting devices and external electrical interference.
Dropped Frames	Number of dropped frames due to delivery problems. Recommendations: Check the network interface card.
CRC Errors	The amount of frames with invalid CRCs.
Frames Transmitted	
Correct Frames	The number of frames successfully transmitted. When a valid connection is established the number should increase steadily.
Correct Octets	The number of octets successfully transmitted. When a valid connection is established the number should increase steadily.
Collisions	The number of successfully transmitted frames which transmission is inhibited by a collision event. A collision occurs in half-duplex connection when two devices try to transmit at the same time. This counter tracks the number of times frames have collided. This event exists only in Half Duplex mode, which is not recommended in an IPmux application. Recommendations: Many collisions indicate that the traffic is too heavy for a half-duplex media. Set to a Full-Duplex environment if possible.

Bundle Connection Statistics

The Bundle Connection Status screen provides information about the integrity of the TDMoIP connection, including the status of the Jitter Buffer. (Each bundle has it own independent jitter buffer).

➤ **To view the Bundle connection status:**

- Access the control port terminal via:
  Main Menu > Performance Monitoring > Bundle Connection Status.

```
                          BUNDLE CONNECTION STATUS
Destination IP Address      192.168.100.2
Next Hop MAC Address:       00-20-D2-18-46-3A
Connectivity Status:        OK

Sequence Errors:            1
Jitter Buffer Underflows:   1
Jitter Buffer Overflows:    1
Last Flip Cause:

ESC. Exit              R. Reset Counters
```

Figure 4-4. Bundle Connection Status

The Bundle Connection Status parameters are:

- Destination IP address
- Next hop MAC address
- Connectivity status
- Sequence errors:
- Jitter buffer underflows
- Jitter buffer overflows.

Table 4-6 lists the Bundle Connection Status parameters.

Table 4-6. Bundle Connection Status Parameters

Parameter	Description
Destination IP Address	The IP address of the opposite IPmux, to which the bundle is destined.
Next Hop MAC Address	Layer 2 applications: the MAC address displayed is the MAC address of the remote IPmux. Layer 3 applications: the MAC address displayed is the MAC address of the connected router.

Table 4-6 Bundle Connection Status Parameters (Cont.)

Parameter	Description
Connectivity Status	Disabled: No activity in the channel. The channel is disabled. OK: Both the remote and the local IPmux receive Ethernet frames, (however, there may be problems such as sequence errors, underflows, overflows, as explained below). Local Fail: The loacal IPmux does not receive Ethernet frames. Remote Fail: The remote IPmux does not receive Ethernet frames. Unavailable: The remote Ipmux does not reply to OAM messages (only applicable when OAM is enabled). Validation Fail: The remote Ipmux replies, but there is a configuration error (only applicable when OAM is enabled). Standby: Redundant bundle is OK and wiaitng for redundancy switching (only applicable when Redundancy is enabled). TDM Fail: There is LOS/LOF at the TDM side (only applicable when Redundancy is enabled). *Note: While under Disable or Local Failure or Remote Failure status, the statistic counters will be inactive.*
Destination IP Address	The IP address of the opposite IPmux, to which the bundle is destined.
Next Hop MAC Address	Layer 2 Applications: the MAC address displayed is the MAC address of the remote IPmux. Layer 3 Applications: the MAC address displayed is the MAC address of the connected router.
Connectivity Status	Disabled: No activity in the channel. The channel is disabled. OK: Both the remote and the local IPmux receive Ethernet frames, (however, there may be problems such as sequence errors, underflows, overflows, as explained below). Local Fail: The loacal IPmux does not receive Ethernet frames. Remote Fail: The remote IPmux does not receive Ethernet frames. Unavailable: The remote Ipmux does not reply to OAM messages (only applicable when OAM is enabled). Validation Fail: The remote Ipmux replies, but there is a configuration error (only applicable when OAM is enabled). Standby: Redundant bundle is OK and wiaitng for redundancy switching (only applicable when Redundancy is enabled). TDM Fail: There is LOS/LOF at the TDM side (only applicable when Redundancy is enabled). ***Note**: While under Disable or Local Failure or Remote Failure status, the statistic counters will be inactive.*

Table 4-6. Bundle Connection Status Parameters (Cont.)

Parameter	Description
Sequence Errors	Each packet transmitted by IPmux holds a sequence number. The receiving IPmux checks these numbers at the receive mechanism and expects to see that each new incoming packet is "in sequence" relative to the previous one (i.e., packet no. 5 is received after no. 4). When, for some reason, this is not the case (i.e., next packet is not in sequence relative to the previous one), this means that there had been a problem with packet flow integrity (and hence data/voice integrity). IPmux will indicate this by increasing the "Sequence Errors" counter by one. There may be two reasons for a Sequence Error notification: • Packet or packets are lost somewhere along the network. • Re-ordering of packets by network. Packet re-ordering may occur due to queuing mechanisms, re-routing by the network, or when the router updates very large routing tables. Recommendations: Make sure IPmux traffic has sufficient bandwidth. See *Chapter 1* for Throughput Calculation. Make sure Ethernet connection is functioning properly. (See *LAN Statistics* above.) Make sure Ethernet/IP network provides priority (Quality Of Service) to the IPmux traffic. Priority may be achieved by three means: VLAN tagging, IP TOS marking or by using the constant 2142 decimal value at the "UDP destination Port" field of each TDMoIP packet. Verify that the IP network devices (switches/routers/modems/etc.) are capable of handling the IPmux PPS rate (Packets Per Second). For PPS Calculations refer to *Chapter 1*. Make sure the network devices do not drop/loose/ignore packets. ***Note**: IPmux-1/1E may support a "reordering mechanism", which can sort packets back to their original order in some situations. For more details, refer to Tech Support.*

Table 4-6. Bundle Connection Status Parameters (Cont.)

Parameter	Description
Sequence Errors	Each packet transmitted by IPmux holds a sequence number. The receiving IPmux checks these numbers at the receive mechanism and expects to see that each new incoming packet is "in sequence" relative to the previous one (i.e., packet no. 5 is received after no. 4). When, for some reason, this is not the case (i.e., next packet is not in sequence relative to the previous one), this means that there had been a problem with packet flow integrity (and hence data/voice integrity). IPmux will indicate this by increasing the "Sequence Errors" counter by one. There may be two reasons for a Sequence Error notification: • Packet or packets are lost somewhere along the network. • Re-ordering of packets by network. Packet re-ordering may occur due to queuing mechanisms, re-routing by the network, or when the router updates very large routing tables. Recommendations: Make sure IPmux traffic has sufficient bandwidth. See *Chapter 1* for Throughput Calculation. Make sure Ethernet connection is functioning properly. (See *LAN Statistics* above.) Make sure Ethernet/IP network provides priority (Quality Of Service) to the IPmux traffic. Priority may be achieved by three means: VLAN tagging, IP TOS marking or by using the constant 2142 decimal value at the "UDP destination Port" field of each TDMoIP packet. Verify that the IP network devices (switches/routers/modems/etc.) are capable of handling the IPmux PPS rate (Packets Per Second). For PPS Calculations refer to *Chapter 1*. Make sure the network devices do not drop/loose/ignore packets. ***Note**: IPmux-1/1E may support a "reordering mechanism", which can sort packets back to their original order in some situations. For more details, refer to Tech Support.*

Table 4-6. Bundle Connection Status Parameters (Cont.)

Parameter	Description
Jitter Buffer Underflow	The IPmux is equipped with a "Packet Delay Variation Tolerance" buffer, also called a "jitter buffer", responsible for compensating for IP networks delay variation (IP jitter). The jitter buffer is configured in milliseconds units and exists for each bundle independently. Explanation: Packets leave the transmitting IPmux at a constant rate, but the problem is that they are reaching the opposite IPmux at a rate which is NOT constant, due to network delay variation (caused by congestion, re-routing, queuing mechanisms, wireless media, half-duplex media, etc.). The TDM devices at both ends require a constant flow of data, so they can't tolerate delay variation. Therefore the Jitter Buffer is required in order to provide the TDM equipment with a synchronous and constant flow. This is done as follows: Upon startup, the jitter buffer stores packets up to its middle point (the number of packets correlates to the buffer's configured depth in milliseconds). Only after that point it starts outputting the E1/T1 flow towards its adjacent TDM device. The stored packets assure that the TDM device will be fed with data even if packets are delayed by the IP network. Obviously, if packets are delayed too long, then the buffer is gradually emptied out until it is underflowed. This situation is called Buffer Starvation. Each underflow event increases the jitter buffer underflow counter by one and indicates a problem in the end-to-end voice/data integrity. The second functionality of the jitter buffer is that in Adaptive mode the jitter buffer is also a part of a mechanism being used to reconstruct the clock of the far end TDM side. An underflow situation can be a cause of: • Buffer starvation: Packets delay variation causes the buffer to empty out gradually until it is underflowed. • Continuous Sequence Errors. The sequence error means a halt in the valid stream of packet arrival into the jitter buffer. • Packets are being stopped/lost/dropped. • Too small jitter buffer configuration that can't compensate for the network delay variation. When all system elements are not locked on the same master clock, it will lead to a situation in which data is clocked out of the jitter buffer at a rate different from the one it is clocked into. This will gradually result in either an overflow or underflow event, depending on which rate is higher. The event will repeat itself periodically as long as the system clock is not locked. When an overflow (see below) situation occurs, the IPmux instantly flashes the jitter buffer, causing a forced underflow. Underflow events initiated by the device (after an overflow event) are not counted by the jitter buffer underflow counter.

Table 4-6. Bundle Connection Status Parameters (Cont.)

Parameter	Description
Jitter Buffer Underflow (cont.)	Recommendations: Try increasing the jitter buffer size. Check reasons for sequence errors or lost/dropped packets (if present), system clocking configuration, Ethernet environment (full duplex) and connection, packets drop/loss/ignore by routers/switches or non-uniform packets output by routers/switches due to queuing mechanisms. Make sure the same amount of TS for bundle is configured on each side of the IPmux application, and that the "TDM bytes in frame" parameter is identical in both IPmux units. Make sure Ethernet/IP network provides priority (Quality Of Service) to the IPmux traffic. Priority may be achieved by three means: VLAN tagging, IP TOS marking or by using the constant 2142 decimal value at each IPmux "UDP destination Port" field.
Jitter Buffer Overflows	The number of times an overflow situation took place. Explanation: In steady state, the jitter buffer is filled up to its middle point, which means it has the space to hold an additional similar quantity of packets. Overflow is opposite phenomenon of the underflow, i.e., when a big burst of packets reaches the IPmux (a burst with more packets than the jitter buffer can store), the buffer will be filled up to its top. In this case, an unknown number of excessive packets are dropped and hence IPmux initiates a forced underflow by flashing (emptying) the buffer in order to start fresh from the beginning. An overflow situation always results in an immediate underflow, forced by the IPmux. After the buffer is flashed, the process of filling up the buffer is started again, as explained above ("underflow" section). An overflow situation can be a cause of: • A big burst of packets, filling up the buffer completely. The burst itself can often be a cause of some element along the IP network queuing the packets and then transmitting them all at once. • Too small jitter buffer configuration. • When system isn't locked on the same clock, it will lead to a situation in which data is clocked out of the jitter buffer at a rate different from the one it is clocked into. This will gradually result in either an overflow or underflow event, depending on which rate is higher. The event will repeat itself periodically as long as the system clock is not locked. Recommendations: Check network devices and try increasing Jitter Buffer configuration. Check system's clocking configuration Make sure the same amount of TS for bundle is configured on each side of the IPmux application, and that the "TDM bytes in frame" parameter is identical in both IPmux units.

4.4 Diagnostic Tests

Maintenance capabilities include external and internal loopbacks.

E1/T1

External Loop

IPmux-1 can be set to an external loop to test the connection between the E1/T1 port and the PBX (refer to *IPmux-1 E1/T1 Configuration* in Appendix E). In this mode, data coming from the PBX is both looped back to the PBX and transmitted forward to the IP network (see *Figure 4-5*).

This mode can also be achieved by a T1 FDL line loopback command.

Figure 4-5. IPmux-1 External Loop

Internal Loop

The E1/T1 module can be set to an internal loop to test the connection between the E1/T1 port and the IP network (refer to *IPmux-1 E1/T1 Configuration* in Appendix E). In this mode (E1/T1 only), data coming from the IP network is both looped back to the IP network and an AIS pattern is transmitted forward to the PBX connected to the E1/T1 port (see *Figure 4-6*).

Figure 4-6. IPmux-1 Internal Loop

➤ **To run a loopback test**

- Press the **<Spacebar>** on your keyboard to toggle between the values: **Internal/External /Disable**.
  - Internal: Data received from the IP network side is looped back to the network transmit line. An unframed all '1' code (AIS) is transmitted in the E1 Tx path toward the PBX. Incoming data from the PBX is ignored.
  - External: Data received from the PBX at the receive E1 line is looped back to the E1 Tx path (toward the same PBX), and continues its way to the IP network. Data coming from the IP network is ignored.
  - Disable: No loopback. Regular operation.

Default value: **Disable**

ISDN BRI

External Loop

An external loop on IPmux-1E can be set to test the ISDN "S' line (*Figure 4-7*). The test is performed on B channels only.

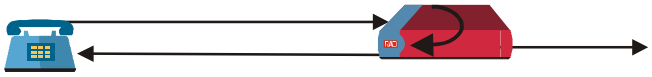

Figure 4-7. IPmux-1E/ISDN External Loop

Internal Loop

An internal loop on IPmux-1E can be set to test the ISDN "S' line (*Figure 4-8*). The test is performed on B channels only.

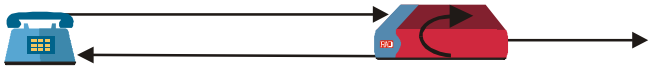

Figure 4-8. IPmux-1E/ISDN Internal Loop

➤ **To run a loopback test:**

- Press the **<Spacebar>** on your keyboard to toggle between the values: **Internal/External /Disable**.
  - Internal: Data received from the IP network side is looped back to the network transmit line.
  - External: Data received from the PBX at the receive ISDN S line is looped back to the ISDN S Tx path (toward the same PBX). Data coming from the IP network is ignored.
  - Disable: No loopback. Regular operation.

Default value: **Disable**

FXS/FXO/E&M

Remote Loopback

You can set a remote loopback analog signal, per port, in IPmux-1E with FXS/FXO/E&M interface. The analog signal is looped back towards the IP network.

Tone Injection

A 1 kHz tone, per port, is injected towards the local telephone set.

➤ **To run a test:**

- Press the **<Spacebar>** on your keyboard to toggle between the values: **Remote Loopback/Tone Injection/Disable**.

Default value: **Disable**

4.5 Frequently Asked Questions

Question: How does the IPmux handle/propagate alarms on the TDM and Ethernet side?

Answer

The IPmux handles alarms on the TDM and Ethernet side in the following manner:

TDM Side Alarms:

Unframed mode:

- In case of LOS (Loss Of Signal) on the local IPmux side, AIS will be sent towards the IP side, and will then be transferred over the E1/T1 to the remote TDM device.
- All other alarms sent from the near-end TDM device (including information on timeslot 0), will be propagated transparently by the local IPmux, to the remote end TDM device (over the IP connection).

  Framed mode:
  In case of LOS/LOF/AIS detected on the local IPmux side, a user-configurable conditioning pattern (00 to FF) will be sent on the relevant time slots (over the IP connection), to the far-end TDM device. A user-configurable conditioning pattern can also be applied on the ABCD bits (CAS signaling 1 to F) going towards the remote PBX.
  The frame synch on the E1/T1 level is maintained in favor of the end TDM devices.

  Ethernet Side Alarms:

  Unframed mode:
  In case of local failure on the IPmux, or a situation of jitter buffer underflow/overflow, an (unframed) AIS will be sent towards the near-end TDM side

  Framed mode:
  In case of local failure on the IPmux, or situation of jitter buffer underflow/overflow, a conditioning pattern (00 to FF) will be sent towards the near-end TDM device on the time slots related to that specific bundle. A user-configurable conditioning pattern can also be applied on the ABCD bits (CAS signaling 1 to F), going towards the local TDM device.
  In this case the synch on the E1/T1 level is maintained in favor of the TDM end devices.

Question: How can I ensure the IPmux TDMoIP traffic priority over an IP Ethernet network?

Answer

The IPmux family is equipped with three different features that can be implemented in order to give the IPmux TDMoIP traffic priority over an IP/Ethernet network:

- VLAN ID (Layer 2)
- ToS field (Layer 3)
- UDP destination port (Layer 4)

Each QoS feature is based on a different OSI level and can be used individually in order to ensure the TDMoIP traffic priority. When determining which feature to use, it is important to verify that the different elements on the network, (switches / routers / etc.), support the selected priority mechanism and are also configured to give the highest priority to the labeled IPmux traffic.
Notice that the priority is given to the TDMoIP traffic by the network elements and the IPmux is merely tagging the packets.

VLAN ID
The IPmux complies with standards IEEE 802.1p&q. This enables the user to set both VLAN ID and VLAN Priority. It adds four bytes to the MAC layer (Layer 2) of the Ethernet frame. These bytes contain information about the VLAN ID, and the VLAN priority, which runs from 0-7. The IPmux only tags the packets, while the Switches are responsible for giving the priority according to the VLAN info. Verify that the IPmux traffic has the highest priority in the relevant Ethernet network.

ToS
There are several RFCs (RFC791, RFC1349, RFC2474) that define how the IP ToS should be configured. The ToS is a byte located in the IP header (Layer 3).
In general the Type of Service octet, in most cases, consists of three fields:
The first field, labeled "PRECEDENCE", is intended to denote the importance or priority of the datagram.
The second field, labeled "TOS", denotes how the network should make tradeoffs between throughput, delay, reliability, and cost.
The last field, labeled "MBZ" (for "must be zero") above, is currently unused.
The IPmux enables configuring the whole IP ToS byte, and therefore it is adaptable to each RFC in the market. The IP ToS parameter in the IPmux is user-configured in terms of decimal value. However, on the frame itself it of course appears in binary format. The decimal value varies between 0 and 255 (8 bits).
A configuration example:
Setting IP precedence of 101 and IP ToS of 1000 will give us the byte 10110000, which means that the IPmux IP-ToS parameter should be configured to 176 decimals.

UDP Destination Port

The IPmux uses the UDP protocol (Layer 4) in order to transfer the TDMoIP traffic. In the UDP protocol, the ¿Destination port¿ field is always set to the decimal value of 2142, hence all the packets leaving the IPmux are tagged accordingly. This unique value was assigned to RAD by the IANA organization for TDMoIP applications.
The network elements may be used to give priority to the TDMoIP traffic according to the UDP destination field.

Question: Does allocating a sufficient bandwidth ensure the proper functionality of an IPmux-based application?

Answer

A sufficient bandwidth is not enough to ensure a steady environment for the IPmux, since networks loaded with additional non-IPmux LAN traffic (e.g. PCs traffic) or incompetent Ethernet/IP network may cause several problems:

- Jitter – The IPmux packets may suffer a delay variation (although all the traffic will eventually pass through due to that fact that there is sufficient bandwidth). Packets will be delayed for different periods of time due to overloaded networks, queuing mechanisms, etc. IPmux can compensate for some jitter (IPmux-1 up to 300 msec, IPmux-4/8/16 up to 32 msec for E1 and 24 msec for T1) but bigger jitter will cause problems.
- Misordering – Packets might be sent in different order than the order in which they were originally sent from the IPmux.
  Note that a certain IPmux version which fixes misordering is available, contact Tech support.
- Packet Loss – Packets might be dropped/ignored by some elements in the network (routers/switches) due to insufficient processing power to handle the load, queuing mechanisms, buffer overflows, etc.

Normally these problems are solved by giving priority to the IPmux traffic over all other traffic.
As can be shown, even though there is sufficient bandwidth, there might still be cases in which the traffic will be transmitted from all the sources at the same time and thus create a momentary load on the network element (router/switch), even when this load that does not exceed the available bandwidth. Since the IPmux is constantly transmitting, the TDMoIP traffic will always be a part of such a load. When no priority is given to the TDMoIP traffic, the network elements will handle the TDMoIP traffic as any other type of traffic.
All the above degrade the performance of the IPmux unit, although an adequate amount of bandwidth is provided for the IPmux.
Please refer to FAQ 3338 to understand how to check the IPmux and network performance and how to solve problems.

Appendix A

Boot Sequence for Downloading Software

This appendix provides a description of the IPmux-1/1E boot procedure via an ASCII terminal for downloading software.

The IPmux-1/1E software is stored in flash memory in two sections, in the boot sector and in the file system. The boot sector holds a boot program that calls up the rest of the program from the file system.

The file system can hold two compressed copies of the IPmux-1/1E code. One copy is called the operating file, and the other is called the backup file. The operating file is the default-executable IPmux-1/1E code. The backup file is used whenever the operating file is absent or corrupted.

A.1 Booting IPmux-1/1E

IPmux-1/1E boots up automatically. After powering up, no user intervention is required, except when the user wants to access the file system to modify or update the software or the IPmux-1/1E configuration.

Boot Sequence

The following is a description of the boot sequence. If the system is working normally, the entire process is completed within 30 seconds. Refer to *Figure A-1*.

```
BOOT Program V 1.21 7-1-2001 08:35
 Flash : size 3e0000h, FileSys sectors 62
   BOOT Program is running !!!
   Checking File System.........-> exists.
   Backup file EXIST
   Operating file EXIST
   Press Cntl-A within 3 seconds to get File-System Menu !!!
   #c1cod code: V 2.00 8-9-2000 11:58
   got start addr : 100000
   Decompression-process........
   Decompression Ended !!!
Jumping to Application, addr = 100008.
```

Figure A-1. Boot Screen

1. The boot program searches for the operating file in the file system
   - If the file exists, a message appears on the screen and the program continues.
   - If the file does not exist, the boot program searches for the backup file, renames the file to Operating file (a message appears on the screen) and continues.
   - If there is no backup file, you must download a file via the out-of-band interface (XMODEM protocol). The received file is saved as the operating file in the file system.
2. Files in the file system are compressed and automatically decompressed into the RAM memory before execution begins. A message appears on the screen.
3. After decompression, the IPmux-1/1E software starts to execute and the user can begin working.

Accessing the File System

The file system menu is an option that allows the user to perform basic file transfer operations. These operations are all optional.

If an operating file exists in the file system, there is a three-second delay.

➤ **To access the file system:**

- Press **<Ctrl-A>** within this delay interval

  The Boot menu is displayed (see *Figure A-2*).

Note

*If you do not press **<Cntl-A>** within three seconds, booting continues normally.*

```
                                BOOT MENU

The device can store two software files in its File System.
One is called Operating file and the Second is called Backup file.
Operating file              EXIST
Backup file                 EXIST
Configuration file          EXIST

0. Exit

1. File swap: Operating⇔Backup

2. Download NEW Operating file
(existing Operating file will be saved as Backup)

3. Delete Operating file
(existing Backup file will be saved as Operating)

4. Delete Configuration file

9. Delete ALL FileSystem (Software and Configuration files)

Type in one of the above option numbers (or <ESC> to exit) :
```

Figure A-2. File System Menu

From the File System menu, you can:

- Exchange the operating and backup files.
- Download a new operating file; the previous operating file is saved as the backup file.
- Delete the operating file; the backup file becomes the operating file.
- Delete the configuration file.
- Delete all the software and configuration files.

If you choose to exchange or delete a file, you are prompted for confirmation.

Appendix B

Telnet

Telnet, which stands for Telecommunications Network, is a protocol that gives you the ability to connect to a remote machine, by giving commands and instructions interactively to that machine, thus creating an interactive connection. In such a case, the local system becomes transparent to the user, simulating a direct connection to the remote computer. The commands typed by the user are transmitted directly to the remote machine and the response from the remote machine is displayed on the user's monitor screen. It is possible to manage the IPmux-1/1E inband via remote ASCII Terminal using the Telnet IP protocol.

B.1 Using Telnet to Manage IPmux-1/1E

Starting a Telnet Session

IPmux-1/1E is normally controlled by an ASCII terminal emulation application running on an OS. To control IPmux-1/1E using Telnet, you must first open a Telnet application on a local PC.

See *Figure B-1* for an example of a Telnet logon dialog box. The Telnet application present on the user's computer may vary in appearance, but will have similar fields.

➤ **To open a Telnet application:**

1. In the **Host Name** field, type the IP number of the IPmux-1/1E.
2. In the **Port** field, choose the Telnet option.
3. In the **TermType** field, choose the ANSI option.
4. Click **Connect**.
5. When prompted, type a valid username and password. The Telnet session is now active.

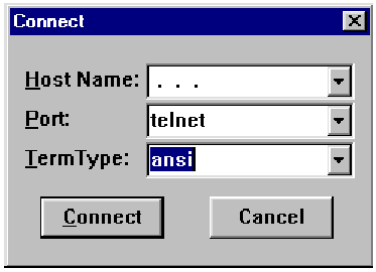

Figure B-1. Telnet Logon Dialog

Telnet Operation

Telnet and ASCII terminal cannot be active at the same time. If a terminal is active, a Telnet session cannot be established.

➤ **To establish a Telnet session:**

- Exit the terminal by selecting Exit in the Main menu.

  If the auto-disconnect is ON, the terminal will be disconnected automatically after 15–30 minutes if no characters were sent (see *ASCII Terminal Configuration* in Appendix E).

  Terminal management has priority over Telnet, if a Telnet session is active and a user logs on to the terminal, the Telnet session will be disconnected and the terminal will be the active form of management.
  Parameters set to default values via Telnet will not erase the host and default gateway parameters, to prevent a loss of connectivity.

Note *When configured to default values from the terminal, Host and Default Gateway parameters will be optionally erased. The user can configure to default parameters and then decide to keep/erase the Host and Default Gateway.*

System Security

A user name and password is required to log on and initiate a Telnet session.

- The terminal session exits to the password screen and the Telnet session disconnects after 15 to 30 minutes of inactivity.

Note

- *The inactivity time-out feature may be deactivated via the ASCII Terminal Configuration window.*
- *Main Menu ⇒ Configuration ⇒ General Configuration ⇒ ASCII Terminal Configurations, menu line 4: 15 Minute Timeout).*

Telnet Access

IPmux-1/1E has the ability to configure Telnet access:

- Enable –Telnet is enabled
- Disable – Telnet is disabled
- Managers – Initially Telnet access is permitted to any outside computer. Once there is at least one manager defined in the Manager's List, Telnet access is allowed only to managers in the list (see *Management Configuration*).

Appendix C

SNMP Management

Appendix C provides specific information for IPmux-1/1E management by SNMP (Simple Network Management Protocol).

The SNMP management functions of IPmux-1/1E are provided by an internal SNMP agent. The SNMP management communication uses UDP (User Datagram Protocol), which is a connectionless-mode transport protocol, part of the IP (Internet Protocol) protocol suite.

This appendix covers the information related to the SNMP environment.

C.1 SNMP Environment

SNMP Principles

The SNMP management protocol is an asynchronous command-response polling protocol. All management traffic is initiated by the SNMP-based network-management station, which addresses the managed entities in its management domain. Only the addressed managed entity answers the polling of the management station (except for trap messages).

The managed entities include a function called an SNMP agent, which is responsible for interpretation and handling of the management station requests to the managed entity, and the generation of properly formatted responses to the management station.

SNMP Operations

The SNMP protocol includes four types of operations:

- **getRequest**: Command for retrieving specific management information from the managed entity. The managed entity responds with a **getResponse** message.
- **getNextRequest**: Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a **getResponse** message.
- **setRequest**: Command for manipulating specific management information within the managed entity. The managed entity responds with a **getResponse** message.
- **trap**: Management message carrying unsolicited information on extraordinary events, which are events that occurred not in response to a management operation reported by the managed entity.

Management Information Base (MIB)

The MIB includes a collection of managed objects. A managed object is defined as a parameter that can be managed, such as a performance statistics value. The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes or types of equipment.

An object definition includes the range of values (also called instances) and the following access rights:

- **Read-only**: Instances of that object can be read, but cannot be set.
- **Read-write**: Instances of that object can be read or set.
- **Write-only**: Instances of that object can be set, but cannot be read.
- **Not accessible**: Instances of that object cannot be read, or set.

MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree.

Each leaf in the MIB is reached by a unique path. Thus, by numbering the branching points starting with the top, each leaf can be uniquely defined by a sequence of numbers.

The formal description of the managed objects and the MIB structure is provided in a special standardized format, called ASN.1 (Abstract Syntax Notation 1). Since the general collection of MIBs can also be organized in a similar structure, under IAB (Internet Activities Board) supervision, any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches). One is the experimental branch and another the group of private (enterprise-specific) branch.

Under the private enterprise-specific branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number. The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIBs. Within this context, RAD has been assigned the enterprise number **164**. Therefore, enterprise MIBs published by RAD can be found under **1.3.6.1.4.1.164**.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, who is responsible for their contents.

MIBs Supported by the IPmux-1/1E SNMP Agent

The interpretation of the relevant MIBs is a function of the SNMP agent of each managed entity. The general MIBs supported by the IPmux-1/1E SNMP agent are:

- rfc1213.mib (except the interfaces view which is supported via RFC 2233)
- ianaiftype.mib (defines the ifType)

- rfc2233.mib (IF-MIB)
- rfc1493.mib
- rfc2665.mib
- rfc1907.mib
- rfc2493.mib
- ces.mib
- rfc2127 (ISDN-MIB)
- rfc2495.mib (except Far End objects and RW configuration objects which are different for each configuration) - replaces RFC 1406; which is now obsolete.
- rfc2494.mib
- rfc2239.mib
- IP-MUX RAD private mib.

The IPmux-1 object id is
iso (1).org(3).dod(6).internet(1).private(4).enterprises(1).rad(164).radGen(6).systems(1).radSysIPMux(3).IPmux1(82)

The IPmux-1E object id is
iso (1).org(3).dod(6).internet(1).private(4).enterprises(1).rad(164).radGen(6).systems(1).radSysIPMux(3).IPmux1E(84)

Enterprise-specific MIBs supported by RAD equipment, including IPmux-1/1E6, are available in ASN.1 format from the RAD Technical Support Department.

Management Domains under SNMP

In principle, SNMP allows each management station that recognizes the MIBs supported by a device to perform all the management operations available on that device. However, this is not desirable in actual practice, it is necessary to provide a means to delimit management domains.

SNMP Communities

SNMP delimits management domains by defining communities. Each community is identified by a name, which is an alphanumeric string of up to 255 characters defined by the user.

The IPmux-1/1E SNMP agent defines strings of up to 10 characters (case sensitive, numeric and alphabetical).

Any SNMP entity (both managed entities and management stations) is assigned a community name by its user. In parallel, the user defines a list of the communities for each SNMP entity that are authorized to communicate with the entity, and the access rights associated with each community (this is the SNMP community name table of the entity).

In general, SNMP agents support two types of access rights:

Read-Only: The SNMP agent accepts and processes only SNMP **getRequest** and **getNextRequest** commands from management stations which have a Read-Only community name.

Read-Write: The SNMP agent accepts and processes all the SNMP commands received from a management station with a Read-Write community name.

Authentication

In accordance with SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, it first checks the originator's community. Messages with community names not included in the SNMP community names table of the recipient are discarded. SNMP agents of managed entities usually report this event by means of an authentication failure trap.

The SNMP agents of managed entities evaluate messages originated by communities appearing in the agent's SNMP community names table in accordance with the access rights, as previously explained. Thus, a **setRequest** for a MIB object with read-write access rights will nevertheless be rejected if it comes from a management station whose community has read-only rights with respect to that particular agent.

Network Management Stations

The IPmux-1/1E SNMP agent stores the IP address of the Network Management Station (NMS) that is intended to manage it.

Appendix D
TFTP Download Procedures

D.1 Inband TFTP Download Procedure

New IPmux-1 software version can be downloaded to IPmux-1 using TFTP. There are three possible procedures:

- Users who access IPmux using Telnet can perform software download and configuration upload/download using the configuration screens. For details, see *TFTP* in Appendix E).
- Users who have access to the RADview network management – for more details refer to appropriate RADview User's Manual.
- Users who access a MIB browser – the TFTP download procedure is illustrated in *Figure D-1*.

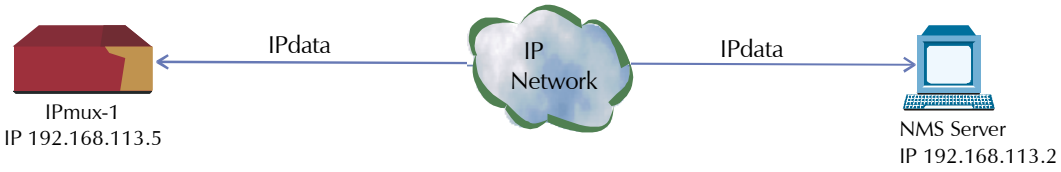

Figure D-1. TFTP Downloading Procedure

The IPmux-1 manager station must be equipped with a TFTP server and the new software.

Warning

The procedures in this chapter should be performed only by a Unix expert.

➤ **To start downloading:**

1. Set the appropriate IPmux-1 MIB parameter. IPmux-1 then sends requests to the TFTP server (where the new software resides) and receives packets of data.
2. If there is no TFTP server available to the main manager, assign a station where there is a TFTP server installed. This server becomes a secondary manager. In this case, the main manager only initiates the download process (by setting the MIB parameter), which is then performed between IPmux-1 and the TFTP server.

Preliminary Procedure

➤ **Before performing TFTP download:**

1. Ping IPmux-1 from the station running the TFTP server to ensure that IPmux-1 has communication with the machine.
2. Log in as **SUPERUSER (su)**.
3. Edit the file named ***inetd.conf*** found at the /**etc** directory, as follows:
   - Search for the line starting with a **#** sign followed by **tftp**, for example, **#** ***tftp*** and delete the **#** sign.
   - At the end of that line, there is ***-S <directory name>***.
     In ***<directory name>*** specify only the path to the file that is to be downloaded to the IPmux-1; for example, /**export**/**home**/**demo**/**tftp**).
4. Save modified file ***inetd.conf*** and **INIT** the Unix machine; for example, in Solaris type ***init 0*** (not the same for SunOS or IRIX or HP-Unix).
5. After the Station reboots, type ***ovw &*** to open ***HPOV***.
6. Open the MIB browser under ***MISC*** → ***SNMP MIB BROWSER***.
7. Type **iso.org.dod.internet.private.enterprises.rad.radGen.agnt.filetranster**; The Browse MIB window showing the Agent IP and Server IP addresses is displayed (see *Figure D-3*).

The fields in are described in *Table D-1*.

Downloading should take between 60 to 120 seconds.

Table D-1. Browse MIB Fields

Field	Description
FileServerIP	Specify the IP address of the TFTP server where the software file resides
FileName	Specify the file name containing the new software version, including any path to the file. This name must be under the root directory where the TFTP server was initiated. The name can be up to 12 characters in length; for example, **anteappl.cmp**
FileTransCmd	Set this parameter to **sw download** (Entry Number 1) to start software download
TftpRetryTimeOut	Specify the desired time interval, in seconds, between retries (**default: 15**)
TftpTotalOut	Specify the retry duration, in seconds (**default: 60**)
MIB Instance	Set to **0** (zero)

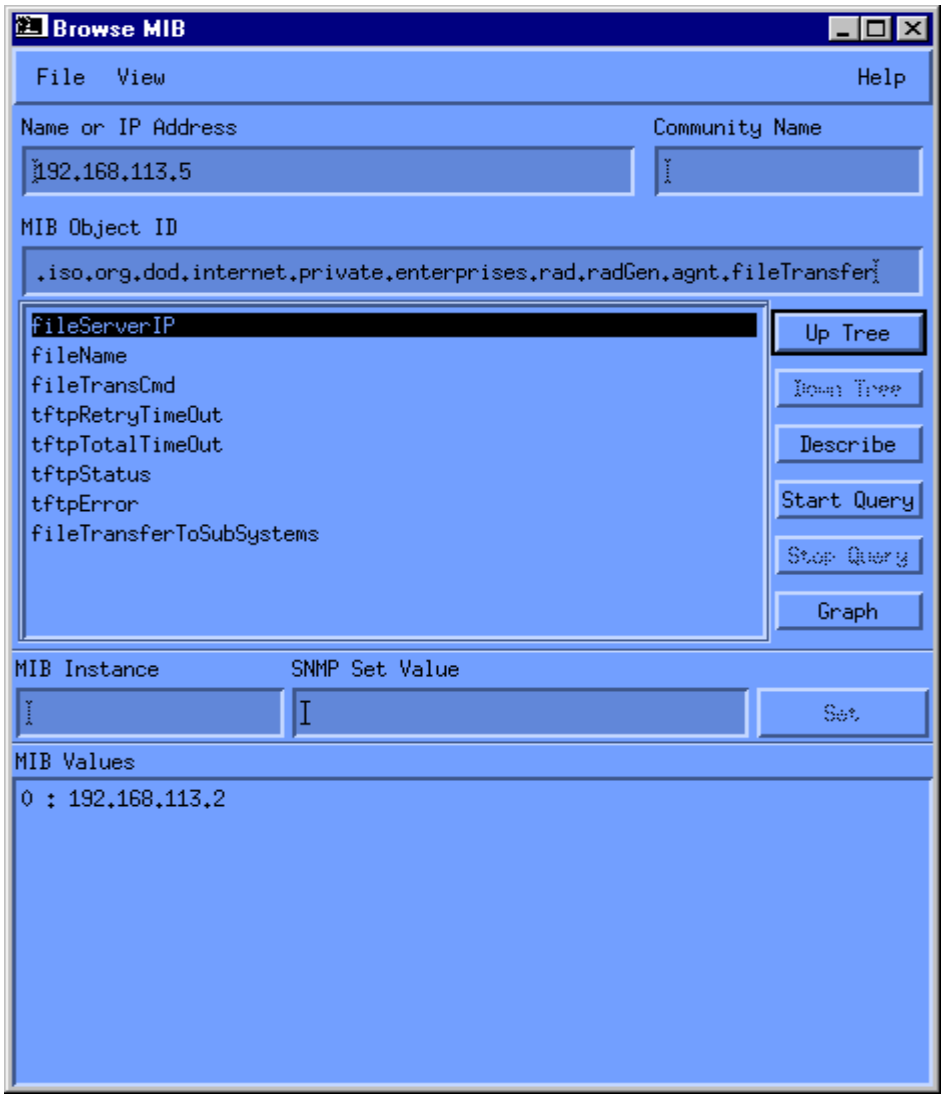

Figure D-2. Agent and Server IP Addresses

Checking the Download

➤ **To check the download:**

1. Log on the MIB Browser again, as follows:
   iso.org.dod.internet.mgmt.mib-2.system.sysDescr.

   The MIB Browser window showing the system description is displayed (see *Figure D-3*).

2. Press <**Start Query**>.

3. Scroll right to check that the application version you have just loaded is the correct one.

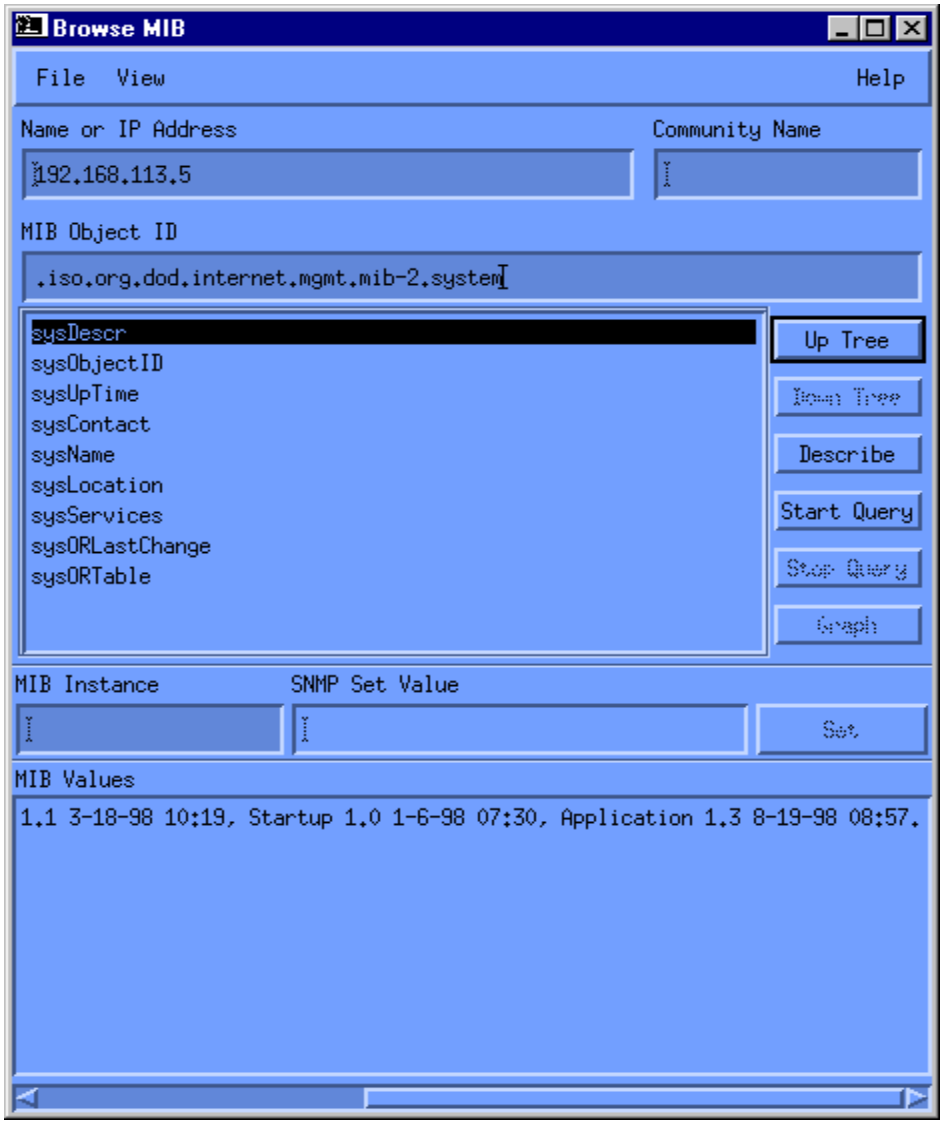

Figure D-3. System Description

Appendix E

Configuration Menus

This appendix illustrates the IPmux-1/1E screens and explains the parameters for:

- Main Menu in *Section E.1*
- Viewing the IPmux-1/1E System in *Section E.2*
  - General Information
  - Self-Test Results
  - Reset
  - System Event Log
  - Logfile Events
  - Ping
- General Configuration in *Section E.3*
  - General Configuration Menu
  - Host IP
  - Default Gateway
  - Management Configuration
  - Authentication/Community
  - Manager List
  - Alarm Traps Mask
  - Telnet Access
  - ASCII Terminal Configuration
  - Time/Date Update
  - Download/Upload Using XMODEM
  - TFTP
  - Set Default Parameters
- IPmux-1 E1/T1 Configuration in *Section E.4*
  - E1 Configuration
  - T1 Configuration
- IPmux-1E Configuration in *Section E.5*
  - ISDN Configuration
  - Analog Configuration

- Connection Configuration for Static Mode in *Section E.6*
  - Bundle Connection Configuration
  - Protection Switching Configuration
- Connection Configuration for Dynamic CAS Mode in *Section E.7*
  - Bundle Connection Configuration
  - Activation Criterion Configuration
- Connection Configuration for CESoIP Mode: Bundle Connection Configuration in *Section E.8*
  - Bundle Connection Configuration
- LAN Configuration (no User port) in *Section E.9*
- DS0 Bundle Configuration in *Section E.10*
- Performance Monitoring in *Section E.11*
  - E1/T1 Statistics
  - ISDN Statistics in IPmux-1
  - Analog Status – IPmux-1E with FXS/FXO/E&M
  - LAN Status (no User port)
  - Bundle Connection Status /Statistics
  - Ethernet Configuration/Status – with User Port in *Section E.12*
  - General Information
  - Aging Time
  - LAN Configuration
  - Erase MAC Table
  - VLAN Configuration
  - LAN Status.

Menu trees for IPmux-1 and IPmux-1E are shown in *Overview of Menu Operations* in Chapter 3.

E.1 Main Menu

The Main Menu options are:

1. System	View and modify system parameters
2. Configuration	Define system configuration
3. Performance Monitoring	Monitor system performance
4. Exit	Exit the control software

```
                    MAIN MENU
1.System                                >
2.Configuration                         >
3.Performance Monitoring                >
4.Exit

Select item from the menu:_
Use keys <1> to <4>
```

Figure E-1. IPmux-1/1E Main Menu

The following sections in this appendix explain the parameters in each of the menu options.

E.2 Viewing the IPmux-1/1E System

General Information

Main Menu
↓
1. System Menu
↓
1. General Information

This screen displays information including software and hardware versions and module descriptions. General Information windows are shown for:

- IPmux-1 E1/T1 in *Figure E-2*
- IPmux-1E ISDN-S in *Figure E-3*
- IPmux-1E FXS in *Figure E-4*.

```
              GENERAL INFORMATION
Software Version            Hardware Version   Inventory No.
Boot: 1.21 4-4-2001 08:46   HW:0.0             321735
Application: 3.00-A3   4-29-2002 17:45
Backup:      2.01A1    10-14-2001 14:09
Interface  Description
  E1 over UTP
  ETHERNET over Singlemode SC

Press ESC to exit
```

Figure E-2. General Information Window

```
                GENERAL INFORMATION
Software Version                Hardware Version   Inventory No.
Boot: 1.21 7-1-2001 08:35       HW:0.0/0.0/0.0          314153
Application: 2.00 9-4-01 12:02
Backup:      2.00 9-4-01 12:02
Interface Description
 ISDN-S over UTP
 ETHERNET over UTP

Press ESC to exit
```

Figure E-3. General Information Window – ISDN

```
                        GENERAL INFORMATION
Software Version                Hardware Version   Inventory No.
Boot: 1.21 7-1-2001 08:35       HW:0.0/0.0         314154
Application: 2.00 9-4-01 12:02
Backup:      2.00 9-4-01 12:02
Interface Description
 FXS over RJ11
 ETHERNET over UTP

Press ESC to exit
```

Figure E-4. General Information Window – FXS

Self-Test Results

Main Menu
↓
1. System Menu
↓
2. Self-Test Results

```
                        SELF-TEST RESULTS
FRAMER TEST.........................PASS
FAST ETHERNET TRANSCEIVER TEST.......PASS

         Press ESC to exit
```

Figure E-5. Last Self-Test Results Window

Table E-1. Last Self-Test Results Parameters

Parameter	Possible Values
Framer Test	**Pass, Fail**
Fast Ethernet Transceiver Test	**Pass, Fail**

➤ **For details:**

- Type **M**. If a problem is encountered refer to *Chapter 4*.

Reset

Main Menu
↓
1. System Menu
↓
3. Reset

➤ **To reset the IPmux-1/1E configuration:**

1. Type **3** (Reset) in the **System Menu**.
   A confirmation message appears.
2. Press **Y** to confirm System Reset for IPmux-1/1E.

```
Are you sure you want a total reset??? (Y/N)
```

Figure E-6. Reset Confirmation Message

System Event Log

Main Menu
↓
1. System Menu
↓
4. Event Log

```
                    System Event Log


1. Read logfile
2. Clear logfile
3. Update Bundle Connection Events:     every 1 min.
4. Bundle Connection Events Threshold:  5
```

Figure E-7. System Event Log Menu

Table E-2. System Event Log

Parameter	Possible Values	Remarks
Update Bundle Connection Events	**Every 1 min.**, **Every 1 sec.**	Interval period
Bundle Connection Events Threshold	**1** to **100**	Number of events that cause a report to be initiated

Logfile Events

Main Menu
↓
1. System Menu
↓
4. Event Log
↓
1. Read Logfile

```
                          LOGFILE EVENTS
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START
 2053-08-07 00:01:20 LOS START          TDM SLOT
 2053-08-07 00:01:20 COLD START


ESC. Exit      N. Next
```

Figure E-8. Logfile Events – Sample Menu

For the full Events List, see *Chapter 4*.

Ping

Main Menu
↓
1.System Menu
↓
5. Ping

This option enables the user to ping other network devices for diagnostic purposes.

➤ **To ping:**

1. Enter the destination IP address and press **<Enter>**.
2. To determine the VLAN tagging, use the **<Space bar>** and then press <**Enter**>. If you select **Yes**, two related fields will come up next as you move through the menu: VLAN ID and VLAN Priority.
3. Enter the VLAN ID and press **<Enter>**.
4. Enter the VLAN priority and press **<Enter>**.
5. To determine the number of ping repetitions, use the **<Space bar>** and then press <**Enter**> to start pinging.

```
                              PING
Enter Destination IP And Press Enter.
Destination IP: 1.1.1.2
Use Space Bar To Choose VLAN Tagging.
VLAN Tagging: Yes
Enter VLAN ID(0..4095) And Press Enter.
VLAN ID: 2
Enter VLAN Priority(0..7) And Press Enter.
VLAN Priority: 6
Use Space Bar To Choose Ping Repetitions.
Ping Repetitions: Endless repeats

    |-----------------------------------------------------|
    | Ping Result: Host 1.1.2.1  Request Timed Out.       |
    | Ping Result: Host 1.1.2.1  Request Timed Out.       |
    | Ping Result: Host 1.1.2.1  Request Timed Out.       |
    | Ping Result: Host 1.1.2.1  Request Timed Out.       |
    | Ping Result: Host 1.1.2.1  Request Timed Out.       |
    |-----------------------------------------------------|

ESC. Stop Pings
```

Figure E-9. Ping Dialog Box

E.3 General Configuration

General Configuration Menu

Main Menu
↓
2. Configuration
↓
1. General Configuration

```
                    General Configuration
1. Host IP
2. Management Configuration
3. ASCII Terminal Configuration
4. Time/Date Update
5. Software Download/Upload
6. Set Default Parameters
7. System Name IPMUX-1
```

Figure E-10. General Configuration Menu

Host IP

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP

➤ **To configure the Host IP address and IP Mask:**

1. On the **Host IP** menu, select **1** and type the **IP Address**.
2. On the **Host IP** menu, select **2** and type the **IP Mask**.

Note *DHCP status (item 5) appears only when DHCP (item 4) is enabled.*

```
                          HOST IP
1. IP Address                 192.168.217.12
2. IP Mask                    255.255.255.0
3. Default Gateway            0.0.0.0
4. DHCP                       Enable
5. DHCP status                >
ESC. Exit
Select item from the menu:_
```

Figure E-11. Host IP Menu

Note *The device reboots if you change any parameter.*

➤ **To change a configured Host IP:**

- Set the device to the default settings.

Note *Frames are not sent until IP and Mask addresses are defined.*

Default Gateway

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP
↓
3. Default Gateway

Default gateway defines the management ***Next Hop***. When Next Hop is not defined for the bundle connection, the Default Gateway Address will be used.

➤ **To configure the Default Gateway:**

- On the **Host IP** menu, select **3** and type the **Default Gateway IP Address**.

Note *The Default Gateway must be in the same subnet as the Host.*

DHCP Status

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
1. Host IP
↓
5. DHCP Status

```
                          DHCP STATUS
 Server ID:                   0.0.0.0
 Lease Expiration Time:       No Active Lease
 Current Status:              Trying to locate available server
ESC. Exit
```

Management Configuration

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
2. Management Configuration

```
                    MANAGEMENT CONFIGURATION
1. Authentication/Community >
2. Managers List            >
3. Alarms Trap Mask         >
4. Telnet Access            Enable

ESC. Exit
Select item from the menu:_
```

Figure E-12. Management Configuration

Authentication/Community

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
2. Management Configuration
↓
1. Authentication/ Community

```
                    AUTHENTICATION/COMMUNITY
1. Authentication Failure Trap          Off
2. Trap                                 public
3. Read                                 public
4. Write                                public

Select item from the menu.
Use <Esc> key or keys <1> to <4>
```

Figure E-13. Authentication/Community Menu

Table E-3. Authentication/Community Parameters

Parameter	Possible Values	Remarks
Authentication Failure Trap	**On** **Off**	On – an authentication-failure trap is generated when a system manager attempts to set a parameter within IPmux-1/1E with an incorrect community value
Trap	Up to 10 alphanumeric characters	The entry is case-sensitive
Read	Up to 10 alphanumeric characters	The entry is case-sensitive
Write	Up to 10 alphanumeric characters	The entry is case-sensitive

Manager List

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
2. Management Configuration
↓
2. Manager List

The Manager List window parameters are used when IPmux-1 inband management capability is used. The parameters define the parameters for up to eight managers. These parameters are:

- Manager IP address
- Host index

In addition, the Manager List window parameters configure the traps to be received by a manager. The default for all traps is **Off**.

➤ **To access additional manager-list parameters:**

- Press **<N>** to go to the next Manager List window.

```
                          MANAGER LIST
1. Manager IP Address                      192.333.234.172
2. Link Up/Down Trap                       On
3. Alarm Trap                              On
5. VLAN Tagging
6. VLAN ID
7. VLAN Priority


ESC. Exit                S. Save           N. Next
Select item from the menu.
Use <Esc> key or keys <1> to <3>
```

Figure E-14. Manager List Menu

Table E-4. Manager List Parameters

Parameter	Possible Values	Remarks
Manage IP Address	**0.0.0.0.** to **255.255.255.255**	Sets the Manager IP address
Link Up/Down Trap	**On**	A Link Up/Down trap will be sent to the manager if there is a physical failure of the LAN or E1/T1 link
	Off	A Link Up/Down trap will not be sent to the manager if there is a physical failure of the LAN or E1/T1 link
Alarm Trap	**On**	The alarm trap informs the manager of the occurrence of any alarm enabled in the Alarms Trap Mask screen. It informs the manager of both entry and exit from an alarm state.
	Off	No Alarm Trap will be sent regardless of the Mask defined in the Alarm Trap Mask screen
VLAN Tagging	**Yes, No**	See *Chapter 1* for an explanation of VLAN tagging. **Yes**: set options 4 and 5 on the System Configuration menu
VLAN ID	**0** to **4095**	**Default: 0**
VLAN Priority	**0** to **7**	**Default: 0**

Alarm Traps Mask

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
2. Management Configuration
↓
3. Alarm Traps Mask

Each of the IPmux-1/1E alarms can activate a trap toward the NMS. It is possible to enable/disable the trap operation for each one of the alarms, using the Alarm Trap Mask screen.

```
                    ALARM TRAPS MASK
1. Alarm ID <refer to Manual>              1
2. Trap Status                             Active


Alarm Active Traps:
Select item from the menu.
Use <Esc> key or keys <1> to <2>
```

Figure E-15. Alarm Traps Mask Menu

Table E-5. Alarm Traps Mask Parameters

Parameter	Possible Values	Remarks
Alarm ID	**1, 2, 6, 8, 21, 26**	IPmux-1/1E alarm
Trap Status	**Active**	Generates an alarm
	Masked	Does not send an alarm
		Default for all traps: **Masked**

Table E-6. IPmux-1/1E Alarms

Alarm ID	Alarm Description	Trap Sent to NMS
1	Loss of Signal (LOS Physical Layer)	Alarm LOS 1.3.6.1.4.1.164.6.1.3.0.7
2	Loss of Frame (LOF Physical Layer)	Alarm LOF 1.3.6.1.4.1.164.6.1.3.0.8
6	Alarm Indication Signal Received (AIS Line Physical Layer)	Alarm AIS 1.3.6.1.4.1.164.6.1.3.0.10
8	Remote Defect Indication Received (RDI Line Physical Layer)	Alarm RDI 1.3.6.1.4.1.164.6.1.3.0.11
21	Far End Block Error (FEBE Line Layer)	Alarm FEBE 1.3.6.1.4.1.164.6.1.3.0.12
26	Connectivity Status	Conn Status Trap 1.3.6.1.4.1.164.6.1.3.0. 15

Note *The other alarms are not used.*

Telnet Access

It is possible to manage the IPmux-1/1E inband via remote ASCII Terminal using the Telnet IP protocol.

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
2. Management Configuration
↓
4. Telnet Access

➤ **To configure Telnet Access:**

- Select:
  - **Enable** –Telnet is enabled
  - **Disable** – Telnet is disabled
  - **Managers** – Telnet is enabled only when the Managers List contains the IP and VLAN of the computer that opens the Telnet session (see *Appendix B*).

ASCII Terminal Configuration

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
3. ASCII Terminal Config

```
                ASCII TERMINAL CONFIGURATION

1. Display Mode          Color
2. Baud Rate (bps)       19200
3. Change Password
4. 15 Min. Timeout       On


ESC. Exit

   NOTICE:  Change the Baud Rate of the ASCII terminal after
          changing and saving of new Baud Rate data !

Select item from the menu:_
Use <Esc> key or keys <1> to <4>
```

Figure E-16. ASCII Terminal Configuration Menu

Table E-7. ASCII Terminal Configuration Parameters

Name	Possible Values	Remarks
Display Mode	**Color** **MonoChrome 3 color** **MonoChrome 2 color**	
Baud Rate	**9600, 19200, 38400, 57600, 115200** bps	**Default: 19200** bps
Change Password		Choose this option to enter a menu that allows the user to change the current password
15 Min. Timeout	**On, Off**	On – terminal/Telnet exits to the password screen if no characters are sent by the terminal for 15 minutes

Time/Date Update

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
4. Time/Date Update

```
                      TIME/DATE UPDATE

1. Set Time (hh:mm:ss)                  16:09:12
2. Set Date (yyyy-mm-dd)                2001-04-17
ESC. Exit


Select item from the menu:_
Use <Esc> key or keys <1> to <2>
```

Figure E-17. Time/Date Update Menu

Table E-8. Time/Date Update Parameters

Parameter	Possible Values	Remarks
Set Time	**00:00:00** to **23:59:59**	Time setting in the device
Set Date	**1970/01/01** to **2099/01/01**	Date setting in the device

Download/Upload Using XMODEM

Main Menu ↓ 2. Configuration ↓ 1. General Configuration ↓ 5. Software Download ↓ **1. Download/ Upload by X-Modem**

Only configuration files can be uploaded. If you enter a software file, the **U. Upload** option is not displayed.

➤ **To Download/Upload using XMODEM:**

1. On the Software Download menu, select **1** (Download/Upload Using XMODEM).

   A confirmation message appears.

2. Select **Y**.

   Upon confirmation, the download or upload procedure begins.

```
                DOWNLOAD/UPLOAD USING XMODEM

1. File                  Application code

ESC. Exit                D. Download


Select item from the menu.

Use <Esc> key or keys <1> to <1>
```

Figure E-18. Download/Upload Using XMODEM Window

Table E-9. Download/Upload Using XMODEM Parameters

Parameter	Possible Values	Remarks
File	**Application code, Configuration code, Boot code**	
Download/Upload	**D**	Download a software or configuration file
	U	Upload a configuration file

TFTP

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
5. Software Download
↓
2. Download/ Upload by TFTP Update

```
                DOWNLOAD/UPLOAD USING TFTP
1. File name
2. Command                                  No Operation
3. Server IP                                0.0.0.0
4. Retry timeout                            15
5. Total timeout                            60
6. View transfer status
ESC. Exit

Select item from the menu.
Use <Esc> key or keys <1> to <6>.
```

Figure E-19. Download/Upload Using TFTP Window

Table E-10. Download/Upload Using TFTP Parameters

Parameter	Possible Values	Remarks
File Name		
Command	**No Operation, Software Download, Configuration Download, Configuration Upload**	
Server IP	**0.0.0.0** to **255.255.255.255**	IP address of the server from which the file is loaded
Retry Timeout	**0** to **10000**	Selected retry timeout period (in seconds)
Total Timeout	**0** to **10000**	Selected total timeout period (in seconds), which is the maximum time allowed for attempted transmission
View Transfer Status		View the transfer status in real-time. It is updated every second. The screen is read-only.

➤ **To save the parameters and start the transmission process:**

- Enter **S**.

  If all parameters are correct, you will be asked for confirmation. After confirmation, the TFTP session begins. You can view the Transfer Status (see *Figure E-20*).

The View Transfer Status values are listed in listed in *Table E-11*.

Notes

1. *Boot code download is not possible using TFTP.*
2. *Reboot the system after you have completed TFTP download via X-Modem screens.*

```
                    VIEW TRANSFER STATUS

Status   Transferring Data

Error    No Error

Use <Esc> key to Exit
```

Figure E-20. View Transfer Status Window

Table E-11. View Transfer Status Parameters

Parameter	Values	Remarks
Status Indication	**No Operation, Connecting, Transferring Data, Ended on Time Out, Ended OK, Error**	
Error Message	**Unavailable (no host IP), No Error, File Not Found, Illegal TFTP Operation, Unknown Transfer ID, Illegal PDU Size, Illegal File Mode, No Empty Connection, No Empty UDP Port, Server Overflow**	

Set Default Parameters

Main Menu
↓
2. Configuration
↓
1. General Configuration
↓
6. Set Default Parameters

Setting Default Parameters reconfigures the device according to default parameters. Before overwriting the system, the warning in *Figure E-21* appears asking you to confirm your selection.

```
Configuration will be overwritten and system will RESET.

Continue ? (Y/N)
```

Figure E-21. Reset Default Warning

➤ **To overwrite the system and reconfigure it according to default settings:**

1. At the prompt (*Figure E-21*), do one of the following:
   - Type **Y**.

     A prompt appears asking for confirmation.

```
Are you sure? Y/N
```

Figure E-22. Reset Confirmation

1. Type **Y**.

   A second prompt appears asking for confirmation (if you have configured the Host):

```
Save Host Connection? Y/N
```

Figure E-23. Host Confirmation

2. Perform one of the following:
   - Type **Y**.

The Default Configuration returns all the Default Settings, except for Host IP, Default Gateway, and Managers.

OR

- Type N.

The Default Configuration returns all the Default Settings, and deletes the Host IP, Default Gateway, and Managers.

OR

- Type **N** to exit and return to the General Configuration menu.

2. Following this, IPmux-1/1E performs an automatic reset.

E.4 IPmux-1 E1/T1 Configuration

IPmux-1 automatically detects whether the interface is E1 or T1, and the appropriate menu appears (see *Figure E-24* and *Figure E-25*).

E1 Configuration

Main Menu
↓
2. Configuration (E1)
↓
2. E1/T1 Configuration

```
                    E1 CONFIGURATION
1. Channel Status                    Enable
2. Transmit Clock Source             Adaptive
3. Loopback State                    Disable
4. Rx. Sensitivity                   -10dB
5. Line Type                         CRC4 enable
6. Idle Code                         7E
7. Uplink Fail Alarm Behavior        Cond.
8. Signaling Mode                    CAS enable
9. Cond. Data Pattern                FF
A. Cond. CAS (ABCD) Pattern          01
ESC. Exit

Select item from the menu.
Use <Esc> key or keys <1> to <9>
```

Figure E-24. E1 Physical Layer Configuration Menu

Note

When "unframed" mode is selected, the Idle Code, Signaling Mode, Cond Data Pattern and Cond CAS Pattern fields are not present.
When CAS Disabled is selected, the Cond CAS Pattern field is not present.

Table E-12. E1 Physical Layer Configuration Parameters

Parameter	Possible Values	Remarks
Channel Status	**Enable**	Detection of LOS alarm
	Disable	No detection of LOS alarm
		Default: Enable
Transmit Clock Source	**Adaptive**	Adaptive clock regeneration
	Loopback	E1 recovered receive clock is used as the transmit clock
	Internal	Local clock source is used
		Default: Adaptive
Loopback State	**Internal**	Data received from the IP network side will be looped back to the network transmit line. An unframed all '1' code (AIS) will be transmitted in the E1 Tx path toward the PBX. Incoming data from the PBX will be ignored.
	External	Data received from the PBX at the receive E1 line will be looped back to the E1 Tx path (toward the same PBX), and will continue its way to the IP network. Data coming from the IP network will be ignored.
	Disable	No loopback; regular operation
		Default: Disable
Rx Sensitivity	**-10 dB, -32 dB**	Maximum attenuation of the receive signal that can be compensated for by the interface receive path
		Default: **-10 dB**
Line Type		Framing mode and operation mode for each configuration
	Unframed	Framer will be configured to pass through mode and the operation mode will be set to Transparent (see *Chapter 1*)
	CRC4 Enable	Framer will be configured to CRC4 MF mode. Operation mode will be set by Signaling Mode field #6 to either Fractional or Fractional with CAS (see *Chapter 1*).
	CRC4 Disable	CRC4 MF mode is disabled. Operation mode will be set by Signaling Mode field #6 to either Fractional or Fractional with CAS (see *Chapter 1*).
		***Note**: Changing the Line Type setting disables the Line.*
		Default: CRC4 enabled
Idle Code	**00** to **FF**	Determines the idle code inserted into unused timeslots by IPmux-1 at the transmit path towards E1 equipment.
		***Note**: This field will not appear if "unframed" is selected in the Line Type field.*
		Default: 7E

Table E-12. E1 Physical Layer Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Uplink Fail Alarm Behavior		Selects notification by the agent TDM side if Ethernet link fails
	Cond	IPmux-1/1E sends a Cond. Error that was configured by the user
	AIS	IPmux-1/1E transmits unframed AIS on the E1 channel that was connected to the LAN
Signaling mode	**CAS enable**	The E1 framer is set to CAS MF mode and the operation mode to fractional with CAS mode.
	CAS disable	CAS MF will not be set in the E1 framer and the operation mode will be configured to fractional mode.
		***Note**: This field will not appear if "unframed" is selected in the Line Type field.*
		Default: CAS Enable
Cond. Data Pattern	**00** to **FF**	Conditioning pattern can be applied to timeslots toward the IP path when loss of signal, loss of frame or AIS is detected at the E1 line. Conditioning pattern can also be applied to timeslots toward the E1 line when packet receive buffer overrun or under-run occurs. In Unframed mode, conditioning state will result in AIS transmission. This will be applied when a LOS is detected at E1 line, or when packet receive buffer overrun or under run occurs.
		***Note**: This field will not appear if "unframed" is selected in the Channel Type field.*
		Default: FF
Cond. CAS (ABCD) Pattern	**1** to **F**	The ABCD conditioning pattern can be applied toward the IP path when loss of signal, loss of frame, or AIS is detected at the E1 line. Conditioning pattern can also be applied toward the E1 line when packet receive buffer overrun or underrun occur.
		***Note**: This field will not appear if "Unframed" is selected in the Channel Type field.*
		Default: 1

T1 Configuration

Main Menu
↓
2. Configuration (T1)
↓
2. E1/T1 Configuration

```
                    T1 CONFIGURATION
1. Channel Status                       Enable
2. Transmit Clock Source                Adaptive
3. Loopback State                       Disable
4. Line Type                            T1-ESF
5. Line Code                            B8ZS
6. Line Mode                            DSU
7. Line Length (ft)/Tx Gain (dB)        0-133
8. Restore Time                         1 second
9. Idle Code                            7E
A. Uplink Fail Alarm Behavior           Cond.
B. Signaling Mode                       CAS enable
C. Cond. Data Pattern                   7F
D. Cond. CAS (AB/ABCD) Pattern          01
E. Cond. CAS first 2.5 sec pattern(FF=NULL) FF

ESC. Exit
Select item from the menu.
```

Figure E-25. T1 Physical Layer Configuration Menu

Note

When "unframed" mode is selected, the Restore Time, Idle Code, Signaling Mode, Cond Data Pattern, Cond CAS (AB/ABCD) Pattern and Cond. CAS first 2.5 sec pattern (FF=NULL) fields are not present.
When CAS Disabled is selected, the Cond CAS Pattern and Cond. CAS first 2.5 sec pattern (FF=NULL) fields are not present.

Table E-13. T1 Configuration Parameters

Parameter	Possible Values	Remarks
Channel Status	**Enable**	Detection of LOS alarm
	Disable	No detection of LOS alarm
		Default: Enable
Transmit Clock Source	**Adaptive**	Adaptive clock regeneration
	Loopback	T1 recovered receive clock is used as the transmit clock
	Internal	Local clock source is used
		Default: Adaptive

Table E-13. T1 Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Loopback State	**Internal**	Data received from the IP network side is looped back to the network transmit line. An unframed all '1' code (AIS) is transmitted in the T1 Tx path toward the PBX. Incoming data from the PBX is ignored.
	External	Data received from the PBX at the receive T1 line is looped back to the T1 Tx path (toward the same PBX), and continues its way to the IP network. Data coming from the IP network is ignored.
	Disable	No loopback – Regular operation
		Default: Disable
Line Type		Framing mode and operation mode for each configuration:
	T1-D4	Framer is configured to T1-D4 mode. Operation mode is set by Signaling mode field #6 to either Fractional or Fractional with CAS (see *Chapter 1*).
	T1-ESF	Framer will be configured to T1-ESF mode. Operation mode will be set by signaling mode field #6 to either Fractional or Fractional with CAS (see *Chapter 1*).
	Unframed	Framer will be configured to pass through mode and the operation mode will be set to unframed (see *Chapter 1*).
		Default: T1-ESF
Line Code	**B7ZS, B8ZS, AMI**	**Default: B8ZS**
Line Mode	**DSU, CSU**	**Default: DSU**
Line Length / Tx Gain	**DSU: 0-133 ft, 134-266 ft, 267-399 ft, 400-533 ft, 534-655 ft**	**Default: 0** to **133 ft**
	CSU: 0 dB, -7.5 dB, -15 dB, -22.5 dB	
		Default: 0 dB
Restore Time	**1 second, 10 seconds**	Selects the T1 red alarm recovery time **Default: 1 second**
Idle Code	**00** to **FF**	Inserted into unused timeslots by IPmux-1 at the transmit path towards T1 equipment
		***Note**: This field will not appear if "unframed" is selected in the Line Type field.*
		Default: 7E

Table E-13. T1 Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Uplink Fail Alarm Behavior	**Cond**	Selects notification by the agent TDM side if Ethernet link fails IPmux-1/1E sends a Cond. Error that was configured by the user
	AIS	IPmux-1/1E transmits unframed AIS on the E1 channel that was connected to the LAN
Signaling Mode	**CAS enable**	T1 framer is set to CAS mode and the operation mode to Fractional with CAS mode
	CAS disable	CAS mode is not set in the T1 framer and the operation mode is configured to Fractional mode ***Note**: This field will not appear if "Unframed" is selected in the Line Type field.* **Default: CAS Enable**
Cond. Data Pattern	**00** to **FF**	Byte Code applied to timeslots when fault conditions occur Conditioning pattern can be applied to timeslots toward the IP path when loss of signal, loss of frame or AIS detected at the T1 line. Conditioning pattern can also be applied to timeslots toward the T1 line when packet receive buffer overrun or under-run occurs. In Unframed mode, conditioning state results in AIS transmission. This is applied when a LOS is detected at T1 line, or when the packet receive buffer is overrun or an underrun occurs. ***Note**: This field will not appear if "Unframed" is selected in the Channel Type field.* **Default: 7F**
Cond CAS (ABCD) Pattern	**1** to **F**	2 or 4 Bit Code applied to AB(D4) or ABCD (ESF) bits when fault conditions occur The ABCD conditioning pattern can be applied toward the IP path when loss of signal, loss of frame or AIS detected at the T1 line. Conditioning pattern can also be applied toward the T1 line when packet receive buffer overrun or under run occur. ***Note**: This field will not appear if "Unframed" is selected in the Channel Type field.* **Default: 1**

Table E-13. T1 Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Cond. CAS first 2.5 sec Pattern	**0** to **F** (ESF) **0** to **3** (D4) **FF**	2 or 4 Bit Code applied (during the first 2.5 seconds) to AB(D4) or ABCD (ESF) bits (relevant in CAS mode only) when fault conditions occur. After the first 2.5 seconds the code specified in 'Cond. CAS (ABCD) pattern' is applied. ABCD conditioning pattern can be applied toward the IP path when loss of signal, loss of frame or AIS detected at the T1 line. Conditioning pattern can also be applied toward the T1 line when packet receive buffer overrun or underrun occurs. When configuring FF to this function, this parameter is ignored and the CAS pattern applied in the first 2.5 seconds is the same as defined in ' Cond. CAS (ABCD) pattern'. ***Note**: This field does not appear if "Unframed" is selected in the Line Type field or if CAS Disable is selected.* **Default: FF**

E.5 IPmux-1E Configuration

IPmux-1E automatically detects whether the interface is ISDN or Analog, and the appropriate menu appears (see *Figure E-26* and *Figure E-28*).

ISDN Configuration

Main Menu
↓
2. Configuration (ISDN)
↓
2. ISDN Configuration

```
                    ISDN CONFIGURATION
1. Interfaces Mode                      Terminal
2. Transmit Clock Source                Adaptive
3. Channel Configuration                >
ESC. Exit

Select item from the menu.
```

Figure E-26. ISDN Configuration Menu

Table E-14. ISDN Configuration

Parameter	Possible Values	Remarks
Interfaces Mode	**Terminal**	ISDN S ports are in TE mode*
	Network	ISDN S ports are in NT mode
Transmit Clock Source	**Adaptive**	Adaptive clock regeneration
	Loopback	Only when IPmux-1E ISDN BRI ports are configured as TE mode – clock is taken from the opposite NT device connected to Channel 1
	Internal	Local clock source is used
Channel Configuration		Next screen

*Terminal mode can be enabled only when Phantom Feeding is disabled. This can be performed by the IPmux-1E ISDN-S module jumpers. For further information, see *Setting Internal Jumpers* in Chapter 2.

ISDN Channel Configuration

Main Menu
↓
2. Configuration (ISDN)
↓
2. ISDN Configuration
↓
3. ISDN Channel Configuration

```
                ISDN CHANNEL CONFIGURATION
1. Channel Number                          1
2. Channel Status                          Enable
3. Loopback Status                         Disable
4. Phantom Feeding                         Disable
ESC. Exit


Select item from the menu.
```

Figure E-27. ISDN Channel Configuration Menu

Table E-15. ISDN Channel Parameters

Parameter	Possible Values	Remarks
Channel Number	**1, 2, 3, 4**	Select chanel to be configured
Channel Status	**Enable**	Channel is enabled
	Disable	Channel is disabled
Loopback State	**Disable**	No loopback; regular operation
	Internal	An internal loop on IPmux-1E tests the ISDN S line
	External	An external loop on IPmux-1E tests the ISDN S line
Phantom Feeding	**Enable, Disable**	Read-only according to jumper setting on the board

Analog Configuration

Main Menu
↓
2. Configuration (Analog)
↓
2. Analog Configuration

```
                    ANALOG CONFIGURATION
1. Clock Source                          Adaptive
2. Far End Type                          E1
3. Channel Configuration                 >
4. Signaling Profile Configuration       >
5. Signaling Feedback
6. Signaling Mode
7. Wiring
ESC. Exit
            +---------------------------------------+
            |NOTICE: The connection must be disabled |
            |before changing the Clock Source or the |
            | Far End Type!              |
            +---------------------------------------+

Select item from the menu.
```

Figure E-28. Analog Configuration Menu

Table E-16. Analog Configuration

Parameter	Possible Values	Remarks
Clock Source	**Internal**	Local clock source is used
	Adaptive	Adaptive clock regeneration
Far End Type	**E1**	Sets A-Law/μ-Law and TDMoIP® encapsulation mode
	T1-ESF, T1-D4	
Channel Configuration		Next screen
Signaling Profile Configuration		Next screen
Signaling Feedback		Valid only for FXO
Signaling Mode	**Type1, Type2, Type3, Type5 (SSDC5)**	Valid only for E&M
Wiring	**2-Wire, 4-Wire**	Valid only for E&M

Analog Channel Configuration

Main Menu
↓
2. Configuration (Analog)
↓
2. Analog Configuration
↓
3. Channel Configuration

```
                    CHANNEL CONFIGURATION
1. Channel Number                       1
2. Channel Status                       Enable
3. Rx Gain                              -4dBm
4. Tx Gain                              0dBm
5. Testing                              Disable
6. Echo Cancellation Status             Disable
ESC. Exit


Select item from the menu.
```

Figure E-29. Channel Configuration Menu

Table E-17. Analog Configuration

Parameter	Possible Values	Remarks
Channel Number	**1,2,3,4**	Selects channel to be configured
Channel Status	**Enable**	Channel is enabled
	Disable	Channel is disabled
Rx Gain	**-10, -8, -6, -4, -2, 0, 1, 2, 3, 4, 5** (dBm)	Sets the gain towards the phone
Tx Gain	**-10, -8, -6, -4, -2, 0, 1, 2, 3, 4, 5** (dBm)	Sets the analog gain as transmitted from the phone to configure the analog receiver dynamic range
Testing	**Tone Injection**	1 kHz tone is injected towards the local phone
	Remote Loopback	A remote loopback analog signal is set for IPmux-1E FXS/FXO/E&M
	Disable	
Echo Cancellation Status	**Enable, Disable**	Selectable only with echo cancellation module

Signaling Profile Configuration

Main Menu
↓
2. Configuration (Analog)
↓
2. Analog Configuration
↓
4. Signaling Profile Configuration

```
                SIGNALING PROFILE CONFIGURATION
1. Rx A                                    A
2. Rx B                                    N/C
3. Rx C                                    N/C
4. Rx D                                    N/C
5. Tx A                                    A
6. Tx B                                    1
7. Tx C                                    0
8. Tx D                                    1

ESC. Exit

             +------------------------+
             |  Rx: From Network      |
             |  Tx: To Network        |
             +------------------------+

Select item from the menu.
```

Figure E-30. Signaling Profile Configuration Parameters

Table E-18. Signaling Profile Configuration

Parameter	Possible Values	Remarks
Rx A	**A, A Inverse, N/C**	Specifies which ABCD Signaling Bit (only one), and its polarity, carries the on hook/off hook information from the far-end device
Rx B	**B, B Inverse, N/C**	
Rx C	**C, C Inverse, N/C**	
Rx D	**D, D Inverse, N/C**	
Tx A	**A, A Inverse, 0, 1**	Specifies which ABCD Signaling Bit carries the on hook/off hook information to the far-end device.
Tx B	**B, B Inverse, 0, 1**	
Tx C	**C, C Inverse, 0, 1**	
Tx D	**D, D Inverse, 0, 1**	

Note *For example, if Rx = A, then all other Rx must be NC. If Rx = A Inverse, then all other Rx must be N/C (ignored). Tx can be A, B , 0, 1.*

E.6 Connection Configuration: Static Mode

Note *The Connection Configuration menu changes according to the Connection Mode selection (item 1). This section describes Static mode. For Dynamic CAS mode and CESoIP mode, see separate descriptions later in this manual.*

Main Menu ↓ 2. Configuration ↓ **3. Connection Configuration**

➤ **To configure the connection:**

1. Select **1** to enter the **Connection Mode**. Use the **<Space bar>** to select **Static** and then press <**Enter**>.
2. Enter the **Bundle Connection Configuration** data (described later in this section).
3. Select **3,** enter the **Secondary IP Address**, and press **<Enter>**.
4. Select **4,** enter the **Secondary IP Mask** and press **<Enter>**.
5. Enter the **Protection Switching Configuration** data (described later in this section).

```
                CONNECTION CONFIGURATION
  1. Connection Mode                          Static
  2. Bundle Connection Configuration            >
  3. Secondary IP Address                     Empty!
  4. Secondary IP Mask                        Empty!
  5. Protection Switching Configuration         >
ESC. Exit
```

Figure E-31. Connection Configuration

Table E-19. Connection Configuration

Parameter	Possible Values	Remarks
Connection Mode	**Static**, **Dynamic CAS**, **CESoIIP**	When using redundancy, the connection mode must be set to Static.
Secondary IP Address	**0.0.0.0** to **255.255.255.255**	Configure a virtual IP address to be used as a secondary bundle IP source address
Secondary IP Mask		

Bundle Connection Configuration: Static Mode

Main Menu
↓
2. Configuration
↓
3. Connection Configuration
↓
2. Bundle Connection Configuration

```
                BUNDLE CONNECTION CONFIGURATION
1. Bundle ID                                1
2. IP TOS                                   1
3. TDM Bytes in Frame (x48 bytes)           1
4. Connection Status                        Disable
5. Destination IP Address                   0.0.0.0
6. Next Hop                                 0.0.0.0
7. Destination Bundle                       1
8. Jitter Buffer (x10 µsec) rounded up 1000 µsec steps! 300
9. OAM Connectivity                         Disable
A. Redundancy Function                      None
B. VLAN Tagging                             Yes
C. VLAN ID                                  1
E. VLAN Priority                            00
ESC. Exit
          Calculated bundle throughput [BPS]: 3978080
Select item from the menu.
```

VLAN ID and VLAN Priority are configurable only if VLAN Tagging is set to Yes.

Figure E-32. Bundle Connection Configuration (Static Mode)

Parameters must be configured for each connection. To configure all parameters, first select the bundle ID and then proceed with the parameter configuration.

Note

- *First define the bundle.*
- *When changing the Destination IP Address, Next Hop, or Destination Bundle, the Connection Status must be set to Disable. After you save the changes, Connection Status can be reset to Enable.*

Table E-20. Bundle Connection Parameters: Static Mode

Parameter	Possible Values	Remarks
Bundle ID	**1, 2**	If only one bundle is used, the Bundle ID must be configured as 1.
IP ToS	**0** to **255**	Type of Service – sets the IP ToS field in the IP frames transmitted by the device. ToS configuration configures the **WHOLE** byte, since different vendors may use different bits to tag packets for traffic prioritization. ToS assignment applies to all TDM packets leaving IPmux-1. Default configuration: **0**
TDM Bytes in Frame (x48 bytes)	**1** to **30**	Allows you to set the UDP payload length – this parameter enables reduction of Ethernet throughput (detailed explanation in *Chapter 1*). Default payload: single payload (**1**)

Table E-20. Bundle Connection Parameters: Static Mode (Cont.)

Parameter	Possible Values	Remarks
Connection Status	**Enable**	Connection enabled
	Disable	Frames will not be sent from this connection
Destination IP Address	**0.0.0.0** to **255.255.255.255**	IP address of the destination device
Next Hop	**0.0.0.0 to 255.255.255.255**	Use the ***next hop*** parameter when the Destination IP address is not in the device subnet. In such cases the Ethernet frame is sent to the *next hop* IP. If it is not configured, the default gateway is used. **Default: 0.0.0.0** (not configured) ***Note****: The next hop IP must be in the device subnet.*
Destination Bundle	E1: **1** to **496** T1: **1** to **384**	Bundle number in the destination device
Jitter Buffer	**3** to **300 milliseconds (ms**)	Desired depth of the jitter buffer (PDVT buffer). **Default: 300** (10 x µs), i.e. 3 msec
OAM Connectivity	**Enable** **Disable**	The device starts transmitting at full rate after it detects an active, properly configured, Ipmux on the other side of the line. If the Redundancy Type in the Protection Switching menu is set to 1:1, OAM Connectivity must be set to Enable. **Default: Disable**
Redundancy Function	**None, Secondary, Primary**	Read-only (the value is set according to the selection made in the Protection Switching Configuration menu, see *Figure E-33*).
VLAN Tagging	**Yes** **No**	For an explanation of VLAN tagging, see *Chapter 1*.
VLAN ID	**0** to **4095**	**Default: 1**
VLAN Priority	**0** to **7**	**Default: 7**

Protection Switching Configuration

Main Menu
↓
2. Configuration
↓
3. Connection Configuration
↓
5. Protection Switching Configuration

```
              PROTECTION SWITCHING CONFIGURATION
   1. Primary Bundle ID                              Empty!
   2. Secondary Bundle ID                            Empty!
   3. Redundancy Type                                Empty!
   4. TDM Fail Time                                  Empty!
   5. Event Threshold Window (sec)                   Empty!
   6. Sequence Number Threshold (0=Disable)          Empty!
   7. Underflow/Overflow Threshold (0=Disable)       Empty!
   8. Local Fail Time (msec)                         Empty!
   9. Force Connection                               Empty!
   A. Recovery                                       Empty!
   B. Wait-To-Restore Time (sec)                     Empty!
 ESC. Exit
```

Figure E-33. Protection Switching Configuration Menu

Table E-21. Protection Switching Configuration Parameters

Parameter	Possible Values	Remarks
Primary Bundle ID	**1, None**	Set the active (primary) bundle
Secondary Bundle ID	**1, 2, None**	Set the secondary (redundant) bundle
Redundancy Type	**1+1** **1:1**	Set the redundancy mode
TDM Fail Time	**Disable, Immediate, 100 msec** to **1 sec**	Determine the time period during which a detection of LOS/LOF/AIS alarms will trigger a flip (can also be configured to Immediate)
Event Threshold Window	**1** to **1000** sec	Determine for what period of time the unit will count the error events (SN errors or underflow/overflows). For each new time window the error events counter will be reset.
Sequence Number Threshold	**1** to **1000**	Determine how many Sequence Error events counted in the Event Threshold Window will trigger a flip.
Underflow/Overflow Threshold	**1** to **1000**	Determine how many Underflow/Overflow events counted in the Event Threshold Window will trigger a flip.
Local Fail Time	**0** to **99** sec	If during this user-configurable period of time, Local Fail alarm occurs continuously, a flip is initiated.

Table E-21. Protection Switching Configuration Parameters (Cont.)

Parameter	Possible Values	Remarks
Force Connection	**Disable, Primary, Secondary**	Set a specific bundle to be used as the active bundle disregarding the redundancy status. No flips are initiated if this option is active.
Recovery	**Yes**, **No**	Determine whether after performing a redundancy flip, the unit will try to recover to the primary bundle. The recovery flip takes place only if the primary bundle is functioning. When set to NO, flipping between the bundles occurs only when the present active bundle fails.
Wait-To-Restore Time	**0** to **99** sec	Determine a period of time that the unit has to wait before trying to recover to the primary bundle. This option is relevant only when Recovery option is enabled.

Note *For the first 10 seconds after a switch between bundles, switching back is disabled – even if a threshold is exceeded.*

E.7 Connection Configuration: Dynamic CAS Mode

Main Menu
↓
2. Configuration ➤
↓
3. Connection Configuration

To Configure the Connection:

1. Select **1** to enter the **Connection Mode**. Use the **<Spacebar>** to select **Dynamic CAS** and then press <**Enter**>.

Note *For Dynamic CAS: The E1/T1 Signaling Mode must be configured as CAS Enable.*

2. Enter the **Bundle Connection Configuration** data (described later in this section).

Note *The Bundle Connection Configuration menu for Dynamic CAS Mode differs from the menu used for Static Mode.*

3. Enter the **Activation Criterion** data (described later in this section).

```
                CONNECTION CONFIGURATION

   1. Connection Mode                          Dynamic CAS
   2. Bundle Connection Configuration             >
   3. Activation Criterion                        >
ESC. Exit
```

Figure E-34. Connection Configuration

Bundle Connection Configuration: Dynamic CAS Mode

Main Menu
↓
2. Configuration
↓
3. Connection Configuration
↓
2. Bundle Connection Configuration

```
                BUNDLE CONNECTION CONFIGURATION
1. Bundle ID                                1
2. IP TOS                                   1
3. Active Time Slot Bytes in Frame          24
4. Connection Status                        Disable
5. Destination IP Address                   0.0.0.0
6. Next Hop                                 0.0.0.0
7. Destination Bundle                       1
8. Jitter Buffer (x10 µsec) rounded up 1000 µsec steps! 300
9. OAM Connectivity                         Disable
A. VLAN Tagging                             Yes
B. VLAN ID                                  1
C. VLAN Priority                            00
ESC. Exit
          Calculated bundle throughput [BPS]: 3978080
Select item from the menu.
```

VLAN ID and VLAN Priority are configurable only if VLAN Tagging is set to Yes.

Figure E-35. Bundle Connection Configuration (Dynamic CAS Mode)

Parameters must be configured for each connection. To configure all parameters, first select the bundle ID and then proceed with the parameter configuration.

Note

- *First define the bundle.*
- *When changing the Destination IP Address, Next Hop, or Destination Bundle, the Connection Status must be set to Disable. After you save the changes, Connection Status can be reset to Enable.*

Table E-22. Bundle Connection Parameters: Dynamic CAS Mode

Parameter	Possible Values	Remarks
Bundle ID	**1**	IPmux-1 has a single bundle, with the number set at 1
IP ToS	**0** to **255**	Type of Service – sets the IP ToS field in the IP frames transmitted by the device. ToS configuration configures the **WHOLE** byte, since different vendors may use different bits to tag packets for traffic prioritization ToS assignment applies to all TDM packets leaving IPmux-1 Default configuration: **0**
Active Time Slot Bytes in Frame	**24 to 64**	Number of bytes, per active time slot, that will be sent in every fram transmitted over the Ethernet. The maximum value depends on the number of timeslots.

Table E-22. Bundle Connection Parameters: Dynamic CAS Mode (Cont.)

Parameter	Possible Values	Remarks
Connection Status	**Enable**	Connection enabled
	Disable	Frames will not be sent from this connection
Destination IP Address	**0.0.0.0** to **255.255.255.255**	IP address of the destination device
Next Hop	**0.0.0.0** to **255.255.255.255**	Use the ***next hop*** parameter when the Destination IP address is not in the device subnet. In such cases the Ethernet frame is sent to the *next hop* IP. If it is not configured, the default gateway is used. **Default: 0.0.0.0** (not configured) ***Note****: The next hop IP must be in the device subnet.*
Destination Bundle	E1: **1** to **496** T1: **1** to **384**	Bundle number in the destination device
Jitter Buffer	**3** to **300 milliseconds (ms**)	Desired depth of the jitter buffer (PDVT buffer) **Default: 300** (10 x µs), i.e. 3 msec
OAM Connectivity	**Enable**	The device starts transmitting at full rate after it detects an active, properly configured, Ipmux on the other side of the line.
	Disable	**Default: Disable**
VLAN Tagging	**Yes**	For an explanation of VLAN tagging, see *Chapter 1*.
	No	
VLAN ID	**0** to **4095**	**Default: 1**
VLAN Priority	**0** to **7**	**Default: 7**

Activation Criterion

Main Menu
↓
2. Configuration
↓
3. Connection Configuration
↓
3. Activation Criterion

```
                    Activation Criterion

   1. Pattern ID                                  1
   2. Tx A                                        1
   3. Tx B                                        N/C
   4. Tx C                                        N/C
   5. Tx D                                        N/C


 ESC. Exit            D. Delete                        N. Next
```

Figure E-36. Activation Criterion Menu

Table E-23. Activation Criterion Parameters

Parameter	Possible Values	Remarks
Pattern ID	**1** to **4**	An OR operation will be performed on the pattern defined here At least one pattern must be defined. For each defined pattern at least one bit must be configured to either 0 or 1.
Tx A	**0, 1**	Defines CAS A bit
	N/C	Ignored
Tx B	**0, 1**	Defines CAS B bit
	N/C	Ignored
Tx C	**0, 1**	Defines CAS C bit
	N/C	Ignored
Tx D	**0, 1**	Defines CAS D bit
	N/C	Ignored

E.8 Connection Configuration: CESoIP Mode

Main Menu
↓
2. Configuration
↓
3. Bundle Connection Configuration

➤ **To configure the Connection:**

1. Select **1** to enter the **Connection Mode**. Use the **<Space bar>** to select **CESoIP** and then press <**Enter**>.

Note *For CESoIP: The E1/T1 Signaling Mode must be configured as CAS Disable or the Line Type configured as Unframed.*
To change the Connection Mode from Dynamic CAS to CESoIP:
Change the Connection Mode to Static.
Update the E1/T1 Signaling Mode or Line Type.
Change the Connection Mode to CESoIP

2. Enter the **Bundle Connection Configuration** data (described later in this section).

Note *The Bundle Connection Configuration menu for CESoIP Mode differs from the menus used for Static Mode and for Dynamic CAS Mode.*

3. Enter the **Activation Criterion** data (described later in this section).

```
                CONNECTION CONFIGURATION

  1. Connection Mode                          CESoIP

  2. Bundle Connection Configuration            >

ESC. Exit
```

Figure E-37. Connection Configuration

Bundle Connection Configuration: CESoIP Mode

Main Menu
↓
2. Configuration
↓
3. Connection Configuration
↓
2. Bundle Connection Configuration

```
                BUNDLE CONNECTION CONFIGURATION
1. Bundle ID                              1
2. IP TOS                                 1
3. Packet Delay (mSecs)
4. Connection Status                      Disable
5. Destination IP Address                 0.0.0.0
6. Next Hop                               0.0.0.0
7. Source UDP
8. Destination UDP
9. Jitter Buffer                          300
A. VLAN Tagging                           Yes
B. VLAN ID                                1
C. VLAN Priority                          00
ESC. Exit
          Calculated bundle throughput [BPS]: 3978080
Select item from the menu.
```

VLAN ID and VLAN Priority are configurable only if VLAN Tagging is set to Yes.

Figure E-38. Bundle Connection Configuration: CESoIP Mode

Parameters must be configured for each connection. To configure all parameters, first select the bundle ID and then proceed with the parameter configuration.

Note

- *First define the bundle.*
- *When changing the Destination IP Address, Next Hop, or Destination Bundle, the Connection Status must be set to Disable. After you save the changes, Connection Status can be reset to Enable.*

Table E-24. Bundle Connection Parameters: CESoIP Mode

Parameter	Possible Values	Remarks
Bundle ID	**1**	IPmux-1 has a single bundle, with the number set at 1
IP ToS	**0** to **255**	Type of Service – sets the IP ToS field in the IP frames transmitted by the device. ToS configuration configures the **WHOLE** byte, since different vendors may use different bits to tag packets for traffic prioritization ToS assignment applies to all TDM packets leaving IPmux-1 **Default: 0**
Packet Delay	**1** to **63 msec**	The maximum value depends on the number of time slots.
Connection Status	**Enable**	Connection enabled
	Disable	Frames will not be sent from this connection
Destination IP Address	**0.0.0.0** to **255.255.255.255**	IP address of the destination device

Table E-24. Bundle Connection Parameters: CESoIP Mode (Cont.)

Parameter	Possible Values	Remarks
Next Hop	**0.0.0.0** to **255.255.255.255**	Use the ***next hop*** parameter when the Destination IP address is not in the device subnet. In such cases the Ethernet frame is sent to the *next hop* IP. If it is not configured, the default gateway is used. **Default: 0.0.0.0** (not configured) ***Note****: The next hop IP must be in the device subnet.*
Source UDP	**1796**	Ipmux-1 has a single Source UDP number, 1796, which can not be changed
Destination UDP	**1796** to **65534**	Source UDP is the destination device
Jitter Buffer	**3** to **127 msec**	Desired depth of the jitter buffer (PDVT buffer) **Default: 300** (10 x µs), i.e. 3 msec
VLAN Tagging	**Yes** **No**	For an explanation of VLAN tagging, see *Chapter 1*.
VLAN ID	**0** to **4095**	**Default: 1**
VLAN Priority	**0** to **7**	**Default: 7**

E.9 LAN Configuration (No User Port)

Note *When configuring two LANs, see Ethernet Configuration/Status (User Port).*

Main Menu
↓
2. Configuration
↓
4. LAN Configuration

```
                    LAN CONFIGURATION


1. Auto Negotiation              Enable
2. Max Capability advertised     100baseT Full Duplex
3. Default type                  100baseT Full Duplex
ESC. Exit
Select item from the menu.
```

Figure E-39. LAN Configuration Menu

Table E-25. LAN Configuration Parameters

Parameter	Possible Values	Remarks
Auto Negotiation	**Enable, Disable**	Auto Negotiation mode is according to RFC 2239 **Default: Enable**
Maximum Capabilities Advertised		Maximum Capabilities of the port for the Auto Negotiation process (can be lower then the actual capabilities) **Default: 100baseT Full-duplex**
Default Type	**10BaseT Half-duplex, 10BaseT Full-duplex, 100BaseT Half-duplex, 100BaseT Full-duplex**	**Default: 100baseT Full-duplex** ***Note:*** *This parameter is valid only when the Auto Negotiation mode is disabled (RFC 2239).*

Note

If Auto Negotiation is set to Enable and you experience some incompatibility in the Auto Negotiation process, set Auto Negotiation to Disable and set Default type to the desired mode.
When the physical port is fiber, the operation mode is:
Auto Negotiation Off//full duplex/100 Mbps. This is the only possible setting.

E.10 DS0 Bundle Configuration

This configuration selects the timeslots to be transferred end-to-end for E1/T1 when the operation mode is Fractional or Fractional with CAS. One bundle of timeslots can be configured in the IPmux-1 TDMoIP® link.

Main Menu
↓
2. Configuration
↓
5. DS0 Bundle Configuration

```
                    DS0 BUNDLE CONFIGURATION
1. Timeslot number                          1-1
2. Timeslot Current Status                  SET
3. Echo Cancellation Status                 SET

ESC. Exit

ACTIVE TIMESLOTS IN THIS BUNDLE: 1
FREE TIMESLOTS: 2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,
                18,19,20,21,22,23,24,25,26,27,28,29,30,31

ACTIVE ECHO CANCELLATION TIMESLOTS:

Select item from the menu.
Use <Esc> key or keys <1> to <3>
```

Figure E-40. DS0 Bundle Configuration Menu

Table E-26. DS0 Bundle Configuration Parameters

Parameter	Possible Values	Remarks
Timeslot Number	E1: Timeslot 0 is **always** invalid and timeslot 16 is **not** valid for fractional with CAS data format. T1: Valid timeslots are 1 to 24	
Timeslot Current Status	Free Set	Frees the timeslot from the bundle Adds the timeslot to the bundle
Echo Cancellation Status	Free Set	Echo cancellation status is only available if your model supports it
Active Timeslots in this Bundle		Assigned timeslots (read-only)
Free Timeslots		Unassigned timeslots (read-only)

➤ **To save the change:**

- Type **<S>**.

IPmux-1 associates the new timeslot with the bundle.

E.11 Performance Monitoring

E1/T1 Statistics

Main Menu
↓
3. Performance Monitoring
↓
1. E1/T1 Statistics

E1 models only

```
                        E1 STATISTICS
E1 over UTP
LOS:              0
LOF (Red):        0
LCV:              0
RAI (Yellow):     0
AIS:              0
FEBE:             0
BES:              0
DM:               0
ES:               0
SES:              0
UAS:              0
LOMF:             0
Time Since:       sec   7------Valid Intervals        12----
1. Interval                          0
ESC. Exit   N. Next Inv:
```

Figure E-41. E1/T1 Statistics Menu

The following statistics are valid (and visible) for **ESF and E1-CRC4 modes only**: BES, DM. The following parameters are saved in the **event log**: LOS, LOF, Rcv. Yellow alarm, Rcv. AIS and FEBE.

Compliance to Standards

E1: G.703, G.704, G.804, G.706, G.732, G.823

T1: ANSI T1.403, AT&T TR62411, G.703, G.704, G.804

The alarms and statistics are described in *Table E-27*.

Table E-27. E1/T1 Statistics Parameters

Alarm	Failure	Comments
LOS	Loss of Signal	Sync LED Off • For T1: A second during which 192 contiguous pulse positions have no pulse of either positive or negative polarity (signal is more than 30 dB below nominal amplitude • For E1: A second during which 255 contiguous pulse positions have no pulse of either positive or negative polarity
LOF	Loss of Frame	Sync LED Off • For E1/T1: A second during which an OOF error persists for 2.5 seconds and no AIS error (see below) is detected
LCV	Line Code Violation	Line Code Violation • For T1: A second during which BPV (Bipolar Violation) or EXZ errors have occurred • For E1: A second during which two consecutive BPVs of the same polarity are received BPV is the occurrence of a pulse with the same polarity as the previous pulse. EXZ is the occurrence of a zero string greater than 15 for AMI or 7 for B8ZS. Complies with ITU-TI.431, O.161, G.775 and G.821 standards.
Rcv RAI (Yellow Alarm)	Remote Alarm Indication	Sync LED flashes • For E1/T1, a second during which tan RAI pattern is received from the far end when the far-end framer enters a RED state (Loss of Frame)
AIS	Alarm Indication Signal–Received from User	Sync LED is Off • For T1: A second during which an unframed “all 1” signal is received for 3 milliseconds • For E1: A second during which a string of 512 bits contains fewer than three zero (0) bits
FEBE	Far End Block Error	Number of seconds in which the FEBE indication is received from the remote E1 device (For E1 MF-CRC4 only)
BES	Bursty Errored Seconds (Errored Second Type B)	Number of seconds with from two to 319 CRC error events with no AIS nor SEF (Framing Bit Errors) error detection Complies with AT&T TR-62411 and TR-54016 standards Not applicable if Line Type is set to Unframed (T1-ESF or E1-CRC4 modes)

Table E-27. E1/T1 Statistics Parameters (Cont.)

Alarm	Failure	Comments
DM	Degraded Minutes	A Degraded Minute is calculated by collecting all of the available seconds, subtracting any SESs and sorting the result in 60 second groups A Degraded Minute is a 60 second group in which the cumulative errors during the 60-second interval exceed $1x10^{-6}$ T1-ESF or E1-CRC4 modes
ES	Errored Second (If any error occurs during one second)	For E1/T1: Any second containing the following error events: • CRC • SEF (OOF) • AIS (T1 only) If SES is also active (see below) ES runs for 10 seconds and then stops
SES	Severely Errored Seconds	Any second containing the following errored events is counted as severely errored seconds: For E1/T1: • If 320 or more CRC error events • One or more SEF (OOF) events • One or more AIS events occurred (for T1 only)
UAS	Unavailable Seconds	Activated when there are 10 consecutive SES occurrences and deactivated as a result of 10 consecutive seconds without SES
LOMF	Loss of Framing	Loss Of Framing sequence in timeslot 16 E1 CAS mode only

Table E-28 lists the parameters can be monitored from the Link Status menu.

Table E-28. Link Status Parameters

Parameter	Description
Valid Intervals	Number of 15-minute intervals stored in the system since power-up
Time Since	Elapsed time since the beginning of the current interval (interval 0). This is displayed only when the current interval is monitored.
Interval Number	Number of the interval to be displayed Interval number 0 (zero) is the current interval. The current interval display is continuously updated. The elapsed time since the beginning of the interval is displayed.
Start Time	Time and date when the monitored interval started Displayed only when viewing previous intervals.
Prev	Displays the previous interval From the first interval (current interval = 0) Prev is not visible.
Next	Displays the next interval The number of valid intervals is displayed. From the last valid interval **Next** is not visible.

ISDN Statistics in IPmux-1

Main Menu
↓
3. Performance Monitoring
↓
1. ISDN Statistics

```
                          ISDN STATISTICS
ISDN-S over UTP
LOF (Red):          0


ES:                 0
SES:                0
UAS:                0

Time Since:       710 sec   ------Valid Intervals        11----
1. Interval Number                          0
2. Channel Number                           1/1

ESC. Exit   N. Next Inv:
```

Figure E-42. ISDN Statistics Menu

Table E-29. ISDN Statistics Parameters

Parameter	Possible Values / Remarks
LOF (Loss of Frame)	A second during which a loss of ISDN frame occurs
ES (Errored Second)	IF SES is also active (below) ES runs for 10 seconds and then stops
SES (Severely Errored Second)	Any second containing one or more LOF events
UAS (Unavailable Seconds)	Activated when there are 10 consecutive SES occurrences Deactivated as a result of 10 c0nsecutive seconds without SES

➤ **To view statistics for the next interval:**

- Press **N**.

Analog Status – IPmux-1E with FXS/FXO/E&M

Main Menu
↓
3. Performance Monitoring
↓
1. Analog Status

```
                          ANALOG STATUS
Channel 1:     ON HOOK
Channel 2:     ON HOOK
Channel 3:     ON HOOK
Channel 4:     ON HOOK


ESC. Exit
```

Figure E-43. Analog Status

The options for each channel are:

- **On hook**
- **Off hook**
- **Ringing**.

LAN Status (no User Port)

Main Menu
↓
3. Performance Monitoring
↓
2. LAN Status

```
                          LAN STATUS
Mac Address               00-20-D2-16-3B-3D
Mode                      Half duplex
Rate(Mbps)                10
Status                    Not connected

Frames received from the user
    Correct frames:                    0
    Correct Octets:                    0
    Alignment Err:                     0
    FCS Errors:                        0
Frames transmitted to the user
    Correct frames:                    0
    Correct Octets:                    0
    Sngl Collision:                    0
    Mlty Collision:                    0
    Deferred transm:                   0
    Late Collision:                    0
    Carrier Sense:                     0
Esc. Exit     R. Reset Counters
```

Figure E-44. LAN Status Menu

LAN statistics are not collected in intervals.

➤ **To reset counters:**

Type **R**.

Table E-30. LAN Status

Statistics	Values	Description
MAC Address	Hard Coded	Port local MAC address
Mode	**Half-duplex, Full-duplex**	Port mode is set by either the default mode or via auto negotiation results
Rate	**10 Mbps, 100 Mbps**	Port rate is set by either the default mode or via auto negotiation results
Status	**Not connected, Connected**	Not connected: Link loss Connected: Normal operation
Frames received from the user		
Correct frames		Total number of correct frames received
Correct Octets received		Total number of correct octets received
Alignment Errors		Counter of frames received that are not an integral number of octets in length (RFC 1643)
FCS Error		Counter of frames received that do not pass the FCS check (RFC 1643)
Frames transmitted to the network		
Correct Frames		Total number of frames successfully transmitted
Correct Octets		Total number of octets successfully transmitted
Single Collision	Valid only in half duplex mode (RFC 1643)	Counter of successfully transmitted frames for which transmission is inhibited by exactly one collision
Multiple Collision	Valid only in half duplex mode (RFC 1643)	Counter of successfully transmitted frames for which transmission is inhibited by more than one collision
Deferred Transmission	Valid only in half duplex mode (RFC 1643)	Counter of frames for which the first transmission attempt is delayed because the medium is busy
Late Collision	Valid only in half duplex mode (RFC 1643)	Number of times that a collision is detected on a particular interface later than 512 bit-times into the transmission of a packet
Carrier Sense	Valid only in half duplex mode (RFC 1643)	Number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame

Bundle Connection Status /Statistics

Main Menu
↓
3. Performance Monitoring
↓
3. Bundle Connection Status

```
                BUNDLE CONNECTION STATISTICS


Sequence Errors:                    0
Jitter Buffer Underflows:           0
Jitter Buffer Overflows:            0
MAX Jitter Buffer Deviation         300
Time Since:    00 sec -------- valid intervals   00 -----------


ESC. Exit   N. Next Inv
```

Figure E-45. Bundle Connection Statistics Menu

Main Menu
↓
3. Performance Monitoring
↓
4. Bundle Connection Statistics

```
                   BUNDLE CONNECTION STATUS
Bundle ID:    1
Destination IP Address:      192.168.238.50
Next Hop MAC Address:        00-01-02-03-04-05
Connectivity Status:         O.K.
Sequence Errors:             0
Jitter Buffer Underflows:    0
Jitter Buffer Overflows:     0


1. Bundle ID: 1


ESC. Exit   R. Reset Counters    N. Next
```

Figure E-46. Bundle Connection Status Menu

➤ **To reset counters:**

- Type **R**.

Table E-31. Bundle Connection Status/Statistics Parameters

Parameter	Possible Values / Remarks
Destination IP Address	Destination IP address of the bundle configured under Bundle Connection Configuration
Destination Mac Address	In this screen the Destination Mac Address that is displayed is in fact the resulting Mac Address of the ARP process for the destination IP address

Table E-31. Bundle Connection Status/Statistics Parameters (Cont.)

Parameter	Possible Values / Remarks
Connectivity Status	Detects a valid connection (remote IPmux will confirm it recognizes the connection and it is enabled). The problem occurs when ever an IPmux is either disconnected from the network , shut down or the IP path to it is broken somewhere along the way and the opposite IPmux keeps on transmitting (UDP application). The IPmux starts transmitting at full rate only when it correctly detects a valid connection on the other side of the line (the remote IPmux will confirm it recognizes the connection and it is enabled). **OK** – Ethernet frames are received on the local and remote IPmux-1/1E **Remote Fail –** Ethernet frames are not received by the remote IPmux **Local Fail –** Ethernet frames are not received by the local IPmux-1/1E **Disabled** – Connection is disabled **Validation Fail** – Configuration of the local and remote IPmux units are not compatible **Unavailable** – Remote IPmux is unavailable
Sequence Errors	The number of times a frame was dropped because frames were received from the network with SN fields not equal to the last SN+1 (or 2)
Jitter Buffer Underflows	The number of times frames were dropped because the receive buffer was in an underrun state. The buffer enters underflow state when: • Sequence errors occur • Flow underrun takes place due to PDV expiration • An overflow condition occurs
Jitter Buffer Overflows	Number of times that frames were dropped because the receive buffer exceeded the maximum allowed depth
Max Jitter Buffer Deviation	Maximum devaiation from the middle of the jitter buffer, in units of 10 µs (only for Statistics)

E.12 Ethernet Configuration/Status (User Port)

This section illustrates and describes the menus for IPmux-1/1E when the Ethernet user port is present.

General Information

Main Menu
↓
1. System Menu
↓
1. General Information

```
                    GENERAL INFORMATION
Software Version              Hardware Version   Inventory No.
Boot:    1.21 7-1-2001 08:35  HW: 0.0/1.0        232635
Application: 3.00-D1 9-2-2001 16:55
Backup: 3.00-D1 9-2-2001 16:55
Interface Description
  E1 over UTP
  ETHERNET over UTP

Press ESC to exit
```

Figure E-47. General Information Window – Two Ethernet Ports

Aging Time

Main Menu
↓
2. Configuration
↓
4. Switch Configuration
↓
2. Aging Time

```
                    SWITCH CONFIGURATION
1. LAN Configuration                    >
2. Aging Time <seconds>                 120
3. Erase MAC Table
4. VLAN Configuration                   >

ESC. Exit
Select item from the menu.
```

Figure E-48. Switch Configuration – Two Ethernet Ports

➤ **To select Aging Time:**

Enter a value from **10** to **450 seconds**.

Default: 120 seconds

Note *VLAN Configuration is active only when LAN Configuration sets VLAN tagging.*

LAN Configuration

Main Menu
↓
2. Configuration
↓
4. Switch Configuration
↓
1. LAN Configuration

```
                    LAN CONFIGURATION
1. Channel                                  Network
2. Channel Status                           Enable
3. Auto Negotiation                         Enable
4. Max Capability advertised                100BaseT Full Duplex
5. Default type                             100BaseT Full Duplex
6. VLAN Tagging                             Yes/No
7. Default VLAN
8. Rate limit (kbps) (0-Disable)            100
ESC. Exit                                   N. Next
Select item from the menu.
```

Figure E-49. LAN Configuration – Two Ethernet Ports

Table E-32. LAN Configuration – Two Ethernet Ports

Parameter	Values	Remarks
Channel	**Network, User**	Selects port to be configured
Channel Status	**Enable, Disable**	When disabled, Ethernet LOS Events will not be sent to the Logfile
Auto Negotiation	**Enable, Disable**	Enables the auto-negotiation mode (RFC 2239)
Max Capability Advertised	**10BaseT Full-duplex, 10BaseT Half-duplex, 100BaseT Full-duplex, 100BaseT Half-duplex**	**Default: 100baseT Full-duplex** ***Note:*** *This parameter is valid only when the Auto Negotiation mode is enabled (RFC 2239).*
Default type	**10BaseT Full-duplex, 10BaseT Half-duplex, 100BaseT Full-duplex, 100BaseT Half-duplex**	**Default: 100baseT Full-duplex** ***Note:*** *This parameter is valid only when the Auto Negotiation mode is enabled (RFC 2239).*
VLAN Tagging	**Yes** **No**	Switch works in tag or tag+rate mode No (default) – switch works in basic or rate mode **Default: No**
Default VLAN		VLAN associated with untagged frames arriving at the port. This item is displayed only in user tagged, user untagged, rate+user untagged modes.
Rate limit <0-Disable>	**50k to 5 Mb**: in steps of 50k **5 Mb to 100 Mb**: in steps of 1 Mb	Only relevant to Network port. **Default: 100 Mb**

Notes

- *When VLAN Tagging is enabled at the Network, the bundle and all managers must use VLAN tagging with VLAN ID (VLAN ID not equal to 0).*
- *The Rate Limiter restricts the user port bandwidth:*
  - *In steps of 50K, up to 5M*
  - *From 5M–100M in steps of 1M.*

A more detailed explanation is found in Chapter 1.

Erase MAC Table

Main Menu
↓
2. Configuration
↓
4. Switch Configuration
↓
3. Erase MAC Table

The MAC table is erased automatically every time you change the general operating mode of the switch, or you remove a VLAN membership.

➤ **To erase the MAC Table: x**

1. On the **Switch Configuration** menu, select **3**.

   A confirmation line appears.

```
Traffic will be disrupted. Are you sure?
```

Figure E-50. Erase MAC Table Confirmation

2. Answer **Y** to erase the table.

   Erasing the MAC table takes about 2 seconds, during which time all traffic through the switch is halted.

VLAN Configuration

Note *When working in Basic/Rate modes, a warning prints:* ***VLAN tagging must be enabled for VLAN table to take effect****.*

Main Menu
↓
2. Configuration
↓
4. Switch Configuration
↓
4. VLAN Configuration

```
                          VLAN CONFIGURATION
VLAN ID                    1
Network                    No
User1                      No

Network VLANs:
   User1     VLANs:
   Internal  VLANS:

ESC. Exit
Select item from the menu:
```

Figure E-51. VLAN Configuration

Table E-33. VLAN Configuration – User Tagged, User Untagged, Rate+User Untagged Modes

Parameter	Values	Remarks
VLAN ID	**1** to **4094**	Selects the VLAN to edit. Creates a VLAN entry if the VLAN does not exist.
Network	**Yes**	Network port is a member of VLAN
	No	Network port is not a member
User1	**Yes**	User1 port is a member of VLAN
	No	User1 port is not a member of VLAN

Note *'N' pages between VLANs, 'D' deletes the current VLAN.*

Table E-34. VLAN Configuration – Rate+User Tagged Mode

Parameter	Values	Remarks
VLAN ID	**1** to **4094**	Selects the VLAN to edit. Creates a VLAN entry if the VLAN does not exist.
		'N' pages between VLANs, 'D' deletes current VLAN
Network	**Yes**	Always **Yes**. Switched automatically to **Yes** when moving to this mode
		***Note**: **Network cannot** be switched to **No**.*
User1	**Yes**	Frames of the VLAN coming into the User1 port will come out of the Network port (unless the policing discarded them)
	No	Frames of the VLAN coming into the User1 port will be discarded.

Notes

- *The maximum number of allowed entries is 16.*
- *In Rate+User Tagged mode, **all** the VLANs where User1 is YES, must either be in the range 1–2047 or 2048–4094.*
- *In Tag mode, the Internal port is a member of VLANs used by bundle and managers only.*
- *In Tag+RATE mode, the User1 port cannot be a member of a VLAN used by bundle or manager – this is to remove the impression that the IPmux can communicate through the User1 port in Tag+Rate mode.*
- *'N' pages between VLANs, 'D' deletes the current VLAN.*

LAN Status

Three ports are connected to the internal switch:

- Network
- User
- Internal (TDMoIP®/Host).

Main Menu
↓
3. Performance Monitoring
↓
2. LAN Status

```
                          LAN STATUS
Unit Mac Address          00-20-D2-16-3B-3D
Mode                      Half duplex
Rate(Mbps)                10
Status                    Not connected

Frames received
    Total Frames:                    0
    Total Octets:                    0
    Oversize Frames:                 0
    Fragments:                       0
    Jabber:                          0
    Dropped Frames:                  0
    CRC Errors:                      0
Frames transmitted
    Correct frames:                  0
    Correct Octets:                  0
    Collision:                       0
Channel: Network/User1/Internal

Esc. Exit     R. Reset Counters
Use space to toggle between channels.
```

Figure E-52. LAN Status Menu – Two Ethernet Ports (Network or User)

LAN statistics are not collected in intervals.

➤ **To view statistics for next channel:**

- Press **N**.

```
                          LAN STATUS
Mac Address               00-20-D2-16-3B-3D
Mode                      Half duplex
Rate(Mbps)                10
Status                    Not connected

Frames received
    Total Frames:                    0
    Total Octets:                    0
Frames transmitted
    Correct frames:                  0
    Correct Octets:                  0
Channel: Internal

Esc. Exit     R. Reset Counters          N. Next Channel
```

Figure E-53. LAN Status Menu – Two Ethernet Ports (Internal)

➤ **To reset counters:**

Type **R**.

Table E-35. LAN Status – Two Ethernet Ports

Statistics	Values	Description
MAC Address	Hard Coded	IPmux MAC address
Mode	**Half duplex, Full duplex**	Port mode is set by either the default mode or via auto negotiation results
Rate	**10 Mbps, 100 Mbps**	Port rate is set by either the default mode or via auto negotiation results
Status	**Connected**	Normal operation
	Not connected	Link loss
Frames received		
Total Frames		Total number of correct frames received
Total Octets		Total number of correct octets received
Oversize Frames		Number of frames that are too long, and CRC is valid
Fragments		Number of frames that are shorter than 64 bytes and have an invalid CRC
Jabber		Number of frames that are too long and have an invalid CRC
Dropped Frames		Number of dropped frames due to delivery problems
CRC Errors		Number of good frames with invalid CRC
Frames transmitted		
Correct Frames		Total number of frames successfully transmitted
Correct Octets		Total number of octets successfully transmitted
Collision		A counter of successfully transmitted frames for which transmission is inhibited by collision event, valid only in half duplex mode.
Channel1	**Network, User1, Internal**	

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Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: IPmux-1, IPmux-1E

Publication Number: 114-200-04/04

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

What did you like about the manual?

_____

_____

_____

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Error Report

Type of Error(s) or Problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
- ❒ Illogical flow of information
- ❒ Style (spelling, grammar, references, etc.)
- ❒ Appearance
- ❒ Other _____

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

_____

_____

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_____

Please add any comments or suggestions you may have.

_____

_____

_____

You are:

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